Vol. 10.] 1939. [No. 4.

# AGRICULTURAL JOURNAL

IMP. INST. ENT.
— LIBRARY
11 JAN 1940
SERIAL
SEPARATE

*Issued by the*
*Department of Agriculture, Fiji.*

PRICE, ONE SHILLING.

BY AUTHORITY: HAMISH R. CRAIGIE, GOVERNMENT PRINTER, SUVA.
1939.

## FORMER ISSUES OF AGRICULTURAL BULLETINS.

COPIES of the following Bulletins are available at 1s. each except No. 20 which is 2s. per copy. Those marked with an asterisk are not available in such large numbers as the others:—

*No.*

1. Sisal Hemp in Fiji, 1911.
3. Rhinoceros Beetle in Samoa, 1912.
4. The Banana in Fiji, 1912.
5. Scale Insect on Bananas, 1913.
6. Lemon Grass, 1913.
7. A Mission to Java for a Coleopterous Pest of Bananas, 1914.
8. Coconut Experiments, 1915.
9. Soils of Fiji—I., 1916.
10. Fijian Plant Names, 1918.
11. Alluvial Soils of Fiji, 1919.
12. Leaf Moth of Coconuts, 1919.
*13. Sea Island Cotton, 1920.
*14. Transparent Coconut Scale, 1921.
15. Purple Leaf Moth of Coconuts, 1924.
17. Early Nutfall in Coconuts, 1930.
18. Control of Coconut Spike Moth, 1935.
19. Fruit Fly Investigations, 1936.
*20. Coconut Pests and Diseases, 1938.

Also, unnumbered, The Mosquitoes of Fiji, 1935.

Applications should be accompanied by an international money order addressed to the Director of Agriculture, Suva, Fiji.

---

## ISSUES OF AGRICULTURAL JOURNAL.

NOTES FOR LIBRARIES AND RESEARCH INSTITUTES.

So many requests are received from abroad for parts of the *Agricultural Journal* which were never published that the following list of all issues is given for reference. Attention is directed especially to Volume VII which had only one part:—

| *Vol.* | | | *Vol.* | | |
|---|---|---|---|---|---|
| I | 3 parts, | 1928 | VI | 2 parts, | 1933 |
| II | 4 ,, | 1929 | VII | 1 part, | 1934 |
| III | 3 ,, | 1930 | VIII, | 4 parts, | 1935–7 |
| IV | 4 ,, | 1931 | IX | 4 ,, | 1938 |
| V | 2 ,, | 1932 | | | |

Quarterly publication will be continued in future.

---

## ISSUES OF THE AGRICULTURAL CIRCULAR.

THE following were the numbers and year of issue of the *Circular* :—

| | | | | | |
|---|---|---|---|---|---|
| Vol. | 1, | 1920, 12 parts | Vol. | 4, | 1923, 1 part |
| ,, | 2, | 1921, 5 parts | ,, | 5, | 1924–5, 2 parts |
| ,, | 3, | 1922, 4 parts | | | |

As Number 4 of Vol. 3 was printed as " Volume 4 " and Number 1 of Vol. 4 as " Volume 5 " it would appear from an inspection of a complete set that Volume 4 had only a Part 4 and that there were two issues of Volume 5, Part 1.

—EDITOR.

CONTENTS.

VOLUME 10, No. 4, NOVEMBER, 1939.


| | PAGE |
|---|---|
| ERRATA, VOL. 10, NOS. 2 AND 3. | |
| EDITORIAL .. .. .. .. .. .. .. .. .. | 95 |
| VEGETABLE PRODUCTION *by H. R. Surridge* .. .. .. .. | 98 |
| DALO (*Colocasia*) *by B. E. V. Parham and F. Raiqiso* .. .. | 102 |
| COPRA NOTES *by Dr. H. W. Jack*— | |
| 1. Copra Prices .. .. .. .. .. .. .. | 104 |
| 2. Oil Content of Copra .. .. .. .. .. .. | 104 |
| 3. Digestibility of Coconut Oil .. .. .. .. .. | 105 |
| 4. Uniformity of Copra .. .. .. .. .. .. | 105 |
| 5. Green Copra .. .. .. .. .. .. .. | 106 |
| 6. Copra Drying by Fijians .. .. .. .. .. | 107 |
| 7. Coconut Husking (*Fiji Times and Herald*) .. .. .. | 108 |
| REVIEW—FIG MOTH ON STORED COPRA .. .. .. .. | 108 |
| SMALL ESTATE COPRA DRIER *by Dr. H. W. Jack* .. .. .. | 109 |
| AGRICULTURAL SHOW .. .. .. .. .. .. .. | 110 |
| LIST OF INTRODUCED PLANTS *by B. E. V. Parham* .. .. .. | 112 |
| INTRODUCTION OF TROUT INTO FIJI *by Dr. H. W. Jack* .. .. | 117 |
| CASTRATION OF PIGS *by C. H. Koster* .. .. .. .. .. | 120 |
| RAISING VEGETABLES BY WATER CULTURE *by C. Harvey* .. .. | 121 |
| EXTRACT—*Pleurotropis* TO NEW GUINEA .. .. .. .. | 123 |
| NEW ZEALAND CENTENNIAL EXHIBITION .. .. .. .. | 124 |
| ENTOMOLOGICAL NOTES *by R. J. A. W. Lever*— | |
| 1. A Sand-fly, *Forcipomyia*, Attacking a Caterpillar .. .. | 125 |
| 2. Lantana Bug—*Teleonemia* .. .. .. .. .. | 126 |
| 3. Copra Mite—*Caloglyphus* .. .. .. .. .. .. | 126 |

## ERRATA.

VOL. 10, NO. 2, JUNE, 1939.

Opposite page 63.—For " chromo omes " read chromosomes.

VOL. 10, NO. 3, OCTOBER, 1939.

Page 73.—Delete two lines under first table.
Page 86.—Last line but three, for " hydrate " read hydrated.
Page 89.—For " Soli " read soil and for " Sigotoks " read Sigatoka.
Page 90.—Delete first paragraph, repeated.

# AGRICULTURAL JOURNAL

ISSUED BY THE

DEPARTMENT OF AGRICULTURE, FIJI.

VOL. 10.] NOVEMBER, 1939. [No. 4.

## EDITORIAL.

THE year 1939 approaches its conclusion and will long be remembered in Fiji as a year of incidents.

The exceptional rainfall of the first few months, combined with several "blows," were detrimental to most crops and it is not yet possible to estimate in financial terms, the full effects of the damage which resulted.

The winter was marked by an unusually long spell of delightful weather, which enabled gardeners to produce an abundant and varied assortment of vegetables which proved most welcome and which indicates a growing interest in diversification amongst consumers.

The outbreak of hostilities in Europe shocked the world and drew immediate attention to the necessity of taking steps to effect a greater measure of self-sufficiency in the matter of essential commodities, especially foodstuffs.

District reports definitely indicate that all sections of the community are striving to respond effectively to His Excellency's appeal for a greater production of necessary food crops. Wherever one travels, abundant evidence of the opening up of new patches of cultivation meets the view, so that within a few months locally-produced food crops should be ample. It is, however, of paramount importance that such efforts should be sustained month by month in small areas, rather than that a big area should be planted at once, and further plantings should be neglected; it is hoped that this aim will be kept in mind so as to provide for a continuous succession of varied crops all the year round, thus enabling the average production of rice to be conserved (as padi) and spread over a longer period of the year than usual. At the same time, every possible encouragement should be given to the extension of rice cultivation in the Colony, since rice is one of our most important essential foodstuffs, and it is gratifying that reports from Agricultural Officers and from the Colonial Sugar Refining Company's officials indicate that a materially increased area will be planted with rice in the coming season. These efforts should be continued until imports of rice become unnecessary, and thus save the Colony an annual bill of some £35,000 for this commodity.

Should production of crops other than rice exceed immediate local requirements, more diversification in the diet would be of considerable benefit to the consumers as well as to producers, and there is still much scope for the marketing internally of such produce as eggs, butter, meat, poultry, fresh vegetables and local rice as the standards of living of the rural section of the population improve.

The recent Agricultural Show indicates that a change is taking place in the psychology of the natives of the country, in that they seem more anxious to express their own individualities as peasant farmers and as the numbers of such individualist farmers increase they will undoubtedly give more attention to diverse crops and to mixed farming, with benefit, not only to themselves, but to the community as a whole.

In this issue of the *Journal*, the cultivation of vegetables is stressed by an article dealing with their cultivation, which indicates that a wide selection can be made, and the recent Agricultural Show amply confirms this statement.

The article should provide plenty of food for thought for all those who are anxious to produce vegetables for their own tables, as well as for sale, and it is hoped that its brief instructions may be found to be of practical value.

While the best season of the year for the planting of European vegetables has passed, a wide range is available for planting throughout the year, and particular attention should be paid to the general notes which are included, since for vegetable culture it is essential that growing conditions should be maintained at a high level of fertility.

In addition to the above notes on general vegetable cultivation, an instructive note on the culture of " dalo " (*Colocasia esculenta*), the staple food of the Fijians, is given for the benefit of Europeans and others who may wish to plant this easily grown and nutritious food-crop as an addition to the home-grown food supply.

The introduction of plants of all kinds into the Colony is worthy of more attention than it is wont to receive, and the Departmental Botanist summarises in this issue useful pioneering work performed in plant acclimatisation by well-known residents, who deserve much credit for their worthy endeavours.

The summary is published as a record of useful work done, and because such results may prove of material service to others interested in the establishment of exotic species in the Colony.

The great difficulty of growing exotic plants, trees in particular, in Fiji is exemplified by the fact that over 1,000 coconut palms, which are hardy and well acclimatised, were planted along the Suva Point Road in the last three years, but despite considerable expense in fencing and protecting these palms, about 75 per cent. of the seedlings failed, being killed by grazing cattle, or damaged by children and others, who are careless of the value of general welfare work.

Fortunately, most of the plants mentioned in the summary have been grown on an isolated island where damage by animals is probably more easily controlled than in Suva, but, however, that may be, the summary should prove interesting reading in that most of the plants are of some economic value.

Some copra notes, which portray some of the defects of the Fiji product, should prove of vital interest to planters, merchants and others, who have the welfare of this very important industry at heart.

The constant low values received for the product of this Colony compared with other copra-producing areas is significant, and indicates much room for improvement, if Fiji is to compete with other countries, and with standardised vegetable and animal fats derived from other sources.

The high digestibility of coconut oil compared with all other oils and fats is of practical value in indicating that more domestic use should be made of the local product in preference to the importation of less nutritive products, some of which have even been found to be deleterious to health. This matter is now engaging the attention of the Department in co-operation with a local firm.

The need for more uniformity in locally-produced copra is stressed in a short note, which portrays one of the chief causes of this defect, and advocates more frequent and more regular collecting rounds and the grading of nuts in the initial stages of curing. The unique method of gouging out the " green meat " from split whole fruits, which is customary in Fiji, is not in vogue

in the large copra producing countries, because it is regarded as slovenly and as requiring more actual exertion than husking and then splitting the husked nuts and drying initially in the shell. However well the existing method may suit large estates who employ labour, the small holder can readily produce good copra by adopting the Oriental method and utilising a small holder's kiln, since husking his nuts is not such a difficult task, as shown by the note on " Husking Coconuts." For the benefit of small estate owners and managers, a brief description of a suitable 100 ton copra drier is given in this issue.

Of interest to anglers is a record of an attempt to introduce trout to the highlands of Fiji as an attraction to visitors, as well as residents, and as a variation in the local food supply. Notes culled from various sources are added, and, with a view to stimulating interest in the potentialities of establishing the absorbing and useful hobby of trout fishing in the Colony, those interested are invited to co-operate to form a local acclimatisation society in order to renew efforts to introduce this popular sport. It is anticipated that Mr. Hornell, late Director of Fisheries in Madras, who is officially reporting on the fish situation in Fiji, will give this matter his blessing, and that there will be a satisfactory response from residents to the suggestion to form a local society.

The improvement of pigs in the Colony is one of the aims of the Department of Agriculture, and pure-bred stock of the " middle white " breed is slowly but steadily being multiplied for distribution, as part of the scheme of improvements of these useful animals. As more boars of good quality become available, it will be advisable to take steps to reduce the effectiveness of unsatisfactory boars, and towards this end, a practical note on castration is included for the benefit of intelligent pig owners.

A note on the local Agricultural Show indicates that this year's Show was a pronounced success. Its chief features were the excellency and the variety of the Fijian smallholders' exhibits, and the diversified and well arranged District exhibits, which were easily the best yet staged in the Colony.

Fiji's part in the New Zealand Centennial Exhibition is described briefly in an extract from the local press, and should prove of general interest, as should the article on water-culture for those who do not enjoy facilities for vegetable culture in the ordinary way.

The successful dispatch of another consignment of the Mexican lantana bug to Tonga on board a man-o'-war calls for some comment and it is hoped that this introduction will be more successful than the last now that this Kingdom has as Director of Agriculture—Mr. W. Cotrell-Dormer—who is also an entomologist with experience in the British Solomon Islands.

Of some interest is the occurrence on copra from Ovalau of a mite known on food-stuffs in England and the Continent. As it thrives in mouldy copra of poor quality it is not really a serious pest.

## VEGETABLE PRODUCTION.

By
H. R. SURRIDGE, A.R.C.Sc.(I); B.Sc.
Agricultural Officer.

To assist in maintaining and increasing the food supplies of the Colony is the duty of everyone.

The planting of native food crops is being carried out as routine planting at this time of the year, but for those whose land and time is limited, the following suggestions, if carried out, will add to our food reserves, give variety to diet and the satisfaction to the grower of having produced something by his, or her, own efforts for the table.

The following brief cultural notes are given and will help those who have large or small planting areas, or those whose garden space is limited to such boxes, split cement drums or other utensils which will hold soil and, have therefore, the possibility of growing food crops.

Where boxes or cement drums are being used, a soil mixture of two parts good soil, one part sand, one part cow manure well broken, and the whole thoroughly mixed, will be found suitable for most vegetables that can be grown under such conditions. Wood ashes, or a little lime, added occasionally will benefit the soil and maintain its sweetness. The same applies to gardens, large or small. Also all vegetable refuse should not be thrown away but dug into the soil, there to rot and serve as manure. Artificial fertilisers, such as sulphate of ammonia, nitrate of soda, potash, superphosphate, blood and bone mixture are useful when applied with care to the soil, but are also expensive and may not be obtainable, hence the necessity of using vegetable refuse, lawn mowings and ashes, &c., for manuring the land.

*Lettuce.*—Seed should be sown at fortnightly intervals in shallow boxes, or cement drums, filled with the soil mixture, as recommended above. The soil should be thoroughly watered before sowing the seed. After sowing the seed, either in drills or broadcast, sand or wood ashes should be sprinkled so as to cover them, and then the box shaded. Keep soil moist, and after germination and the plants are big enough to handle, plant out into larger boxes, or the garden, setting the plants six to nine inches apart. Water morning and evening. Protect from slugs by ringing the plants with lime and wood ash.

*Mustard and Cress.*—This health-giving salad and food may be quickly and continuously grown, no soil being required. Secure two shallow saucers or plates, line them with blotting paper, flannel or similar material, soak with clean water, sprinkle mustard seed in one saucer and cress in the other and cover with paper until germination starts. Keep the flannel moist, and the mustard and crees should be ready for consumption in about ten days. Sow at regular intervals to secure a continuous supply.

*Maize.*—A valuable food when eaten in the cob or used as dried grain. In the case of the former, the cob is cooked, in the latter, the grain is usually ground up and the meal used. The land should be well prepared and the seed sown in rows three feet apart, three seeds being sown every two feet or three feet in the rows. Keep the land clean of weeds, and when the young plants are six inches or more in height, the soil should be drawn to them so that they are " earthed " up. Frequent hoeing will keep the weeds down, conserve soil moisture, and if the soil is drawn to the plant, gives a better yield. Cobs should be harvested when nearly full grown and in the " milk " stage, if they are to be used for cooking. Maize takes about 70 days to reach this stage from seed, and about 90 days to reach full maturity

as ripe grain. In this case, the cobs must be thoroughly and quickly dried to secure grain which can be milled or kept for some time. Maize also lends itself to cultivation in boxes and split cement drums, so that the small householder can produce additional food under his restricted conditions.

*Peas.*—Under suitable weather conditions, green peas may be grown very quickly, taking about three months from sowing to picking. Secure garden peas of a dwarf and early maturing variety. Prepare the land if possible by digging a narrow trench nine to twelve inches deep and the width of a spade. Fill in the bottom with about four to six inches of cow manure and garden refuse, then replace the soil originally taken out. Thoroughly press down and water. Leave for a day or two. Take the peas and soak them in water overnight, remove soil from the trench to a depth of two inches and sow the peas in the drill thus formed. The peas should be set at about 1½ inches apart, making a treble line right down the drill. Cover with the soil and press down not too heavily. It is beneficial if a potash and superphosphate manural dressing of about 1½ ozs. per square yard of ground can be given. If this is not possible, give a top dressing of lime, or coral sand. Dwarf peas, when sown thickly as above, do not need staking. Do not sow during the wet season.

*Beans.*—Several kinds of beans may be grown, such as the dwarf or French bean, butter beans, long beans, &c., all of which can be treated similarly to peas, except that the French beans should be set in treble rows, beans about nine inches apart, with the rows not less than two feet apart. This would enable a row of lettuces to be planted between the two treble rows of beans. Long beans may be sown in rows three feet apart. Sowings should be made at intervals of two to three weeks.

*Tomatoes.*—This vegetable responds well to box cultivation as well as garden and field cultivation. Hence it is within the possibility of every one with a backyard as well as those who have larger gardens to grow this valuable vegetable. In box culture, fill the box with half good soil and half cow manure, the latter not too fresh. Make sure that drainage is adequate. A box not less in size than a 56 lb butter box will be found very suitable and useful. Seed should be sown in small seed boxes and when the plants are three to four inches high, they may be pricked out into larger boxes and planted six inches apart. When six inches high, place in their permanent quarters. Prune off side shoots until flowering commences, when not more than three main leading shoots should be allowed to grow to produce fruit. After the first truss of fruit has set, water with liquid manure, if possible, made from chicken guano. A handful of this guano when dry, to about three gallons of water is usually strong enough to ensure good growth, both of the plant and fruit. Soak thoroughly each day, preferably at evening, and on no account allow the box to dry out, otherwise the fruit will be misshapen, and liable to split. If tomatoes are grown in the garden, then they should be set at about 15 inches apart in rows three feet apart. Where chicken manure is obtainable, the soil will be found to give better results than cow manure. The use of the latter, however, is valuable as a moisture retainer and tends to prevent the soil, particularly in boxes, from drying out.

*Brinjal or Egg Plant.*—A useful and nourishing fruit, cooked in curries or sliced and fried. Seed is sown in boxes and the plants, when large enough to handle, are planted out three or four feet apart. May be grown in boxes and trained to stakes, similar to tomatoes. There are three main varieties, white, purple and yellow.

*Beetroot.*—Well-manured soil is required, but fresh manure should not be used since this makes the root fork and spoils shape and usefulness. Sow seeds in rows nine inches apart, and after seeds have germinated thin out to four to five inches between the plants in the rows. Water carefully during dry weather.

*Carrots.*—A most useful and health-giving vegetable, containing essential health vitamins, particularly valuable for children. The roots may be harvested at almost all stages of growth, and may be eaten raw, or cooked. Sow seed in rows nine inches apart, and when large enough, thin out to three or four inches between plants in the rows. If used when half grown they are sweeter and more delicate in flavour than when mature. Use an early variety, *e.g.* (Early Horn), and sow at three weekly intervals.

*Celery.*—Sow seed in boxes and when plants are large enough to handle, prick out into other well-drained boxes, and plant a few inches apart. Prepare trenches three to four feet apart, and about 18 inches deep, working in a large quantity of well rotted manure. When plants are about four inches high, plant in the trenches about six inches between each plant, well watering until plants are established. When plants are about half grown they should be tied up with raffia, or similar material, the trenches lined with old newspaper and the whole carefully earthed up, so that only the green leaves are showing. This bleaches the stems and the paper keeps them clean and free from soil. Water thoroughly in dry weather, and ensure at all times that the ground is moist to maintain even and steady growth. If affected by fungus, spray with Bordeaux mixture.

*Cucumbers.*—The soil should be well manured. If a rich soil mixture is prepared of two parts good loamy soil and one part well-rotted manure, with an admixture of sand to keep it open and porous, this may be used for filling planting holes which should be made about 12 inches deep and 18 inches in diameter at about four feet apart. Plant about six seeds in each hole, and when germinated, thin down to four plants per hole. Keep well watered and when plants start fruiting, use liquid manure. If growth is too luxuriant, nip off the growing points after fruit has formed at about the second leaf beyond the fruit.

*Chinese Cabbage.*—Sow seeds in rows about 12 inches apart, and thin out to 12 inches apart in the rows. Keep well watered and choose a cool place for planting since the heads are liable to " bolt " in hot weather.

*Kohl Rabi or Turnip-Rooted Cabbage.*—This vegetable must be kept growing quickly, hence good soil and liberal waterings are necessary. Sow seed in rows 18 inches apart, and thin out to four to six inches in the rows. Both leaves and root are edible and should be gathered while the bulbs are young and tender.

*Leeks.*—Good rich soil is required. Sow seeds in boxes, and when large enough, transplant into rows 12 inches apart, or in trenches similar to celery. Keep watered in dry weather, using liquid manure. When the plants are of good size, earth them up to blanch the stems.

*Marrows, Pumpkin and Squashes.*—Treat these vegetables similarly to cucumber, except that plantings should be about six feet apart, and only two or three plants left in each hole.

*Mustard Spinach.*—This is a new introduction from Japan, matures very rapidly and a succession may be obtained by repeated sowings. Seed should be sown in drills about 12 inches apart, and the plants thinned down to four to five inches apart. Plants are ready for use in about four weeks. Water freely.

*Ochra or Okra.*—Seeds should be sown in rows three feet apart, and the plants thinned to 18 inches apart in the rows, or the seed may be sown in boxes and transplanted when large enough, allowing not less than 24 inches by 15 inches. Good rich soil produces the best plants. Fruits should be ready for gathering in about 2½ months and onwards. Do not allow them to ripen, otherwide they become tough and fibrous. Botanically this is *Hibiscus esculentus.*

*Onions.*—Onions can seldom be grown to maturity in this climate, but will usually grow to " spring " or salad onion size. A rich soil, well drained, is required. Seed should be sown in rows about nine inches apart, not too thinly, so that as the plants grow they may be pulled leaving the smaller ones to grow more freely until the pulling stage.

*Parsnip.*—A deep rich soil is required, one that was well manured the previous season, otherwise the roots will fork and not be palatable. Sow seed in rows one foot apart, and cover firmly with half inch of soil, or sand. When the plants are well up, thin to two to three inches in the rows. Cultivate frequently, and harvest as roots are required.

*Raddish.*—Sow seeds in rows about nine inches apart, clean, weed and water frequently. Rapid growth is essential to secure tender roots.

*Silver Beet.*—The same procedure as that for beet root is adopted, except that in this case the leaves are used as the vegetable. When gathering the leaves do not cut them below four inches from the ground. In this way a continuous supply of new leaves will be forthcoming for use.

*Shallots.*—The seed in this case consists of small shallot onions which are planted in rows about nine inches apart and four to six inches apart in the rows. Results are best obtained in the drier season.

*Turnips.*—Seed should be sown in drills 12 to 15 inches apart, and the seedlings thinned out to about six inches apart. Frequent weedings should be given and the roots watered freely to ensure rapid and succulent growth.

*Cabbage, Cauliflower, Savoy Cabbage, &c.*, are essentially cool season vegetables, seed of which should be sown about April, the seedlings being transplanted into rich land when about four inches high, allowing rows about two feet apart, cabbage being set at 18 inches apart in the rows and cauliflower about two feet apart. In cool and fairly dry cool seasons, good quality cabbage and cauliflower may be produced in many districts.

*General Notes.*—In maintaining fertility, all plant refuse should be dug into the ground, or else carefully stacked in a heap, making it into a layer of rubbish, a layer of soil with lime added, and this repeated over a period of three months, when the whole should be remade by being dug over and formed into a new heap, allowing for mixing in the change-over. If kept moist, the refuse rots quickly and the compost forms a valuable manure. Many townspeople keep chicks and all manure should be saved and dug into the garden.

In small gardens a type of crop rotation may be practised, first by planting bean crops a little wider than recommended above, and interplanting with other crops, such as lettuce, beetroot, raddish, onion, &c. When the crops have been harvested, everything, including the weeds, should be carefully dug in. This ensures that the roots of the beans, as well as their haulm, will give to the soil the nitrogen stored up within them during their growth to the benefit of succeeding crops.

Wood ashes should also be " returned " to the land, and if this is broadcast along the rows of seedlings, it serves to protect as well as manure them. Wood ash contains soluble potash and phosphate.

*Drainage.*—All boxes and cement drums used should have holes made in the bottom for draining, as well as the bottom covered with rubble, stones or similar coarse material, to ensure drainage. Where the garden is on a slope, the drains should be made across the greatest fall and planting should be made in a similar way along the contour. This will conserve the soil and assist in preventing it from being washed away during heavy rain.

*Seeds.*—Large seeds which may be eaten by rats and other ground vermin, may be protected by rolling in a mixture of red lead and kerosene, sufficiently wet to make the mixture adhere to the seed.

To facilitate germination, large seeds may be soaked for 24 hours, and in the case of seed of pumpkin, marrow, &c., the point of the seed should be set downwards, otherwise the moisture may be held in the seed-coat and cause the seed to rot before germination is completed.

---

## DALO (*Colocasia esculenta.*)

By
B. E. V. PARHAM, Agricultural Officer,
and
FILIMONE RAIQISO, Native Field Assistant.

Dalo has for long been an important domestic root crop throughout the tropics; and in Fiji, in recent years, it has become a valuable cash crop, having a ready local sale in the market of the main centres of population. It is an ideal crop for the small-holder in Fiji where the climate is most favourable for heavy yields and where pests and diseases do little or no damage. The crop is one of the easiest to cultivate and market.

*Varieties.*—There are a great many named varieties of dalo grown in Fiji but the following are among the best for all purposes: Vavai and its variants, Samoa, Sisiwa, Vutikoto, Kurokece, Toakula, Tausala ni Samoa, Tausala and mumu. Of these Europeans prefer Vavai (also known as Dalo basaga), Indians prefer Dalo Samoa and Fijian consider Vavai, Samoa, Vutikoto and Sisiwa among the best varieties. Tausala is not highly regarded.

*Soil requirements.*—Dalo may be grown in a variety of soils but does best in well-drained alluvial loams where there is a good supply of moisture and humus, and in black soapstone soils in the wet zone. It is also planted in the wet zone on hill slopes of inferior red soil where the growth is not good and the yields are comparatively poor.

*Preparation of Land.*—In the wet zone the land is cleared of forest or undergrowth, burned if possible and dug with forks and made up into narrow beds with drains to carry off surface water. The land may be prepared with the plough. The dug over plots are usually left for a day or two to permit the surface to dry out before being planted

In the dry zone, dalo is frequently grown in an irrigated terraced bed through which water is lead from a nearby stream.

*Planting and spacing.*—Planting is best done with the aid of a digging stick (called by the Fijian "ai sau") but a fork or spade may be used. Using a digging stick—the cultivator, with a few dexterous strokes makes a coneshaped hole from 12 to 18 inches deep, wider at the bottom (9″) than the top (3″ or 4″). Some 25 holes can be made by one man in an hour: and the size of the holes varies with the size of the planting material available. The average spacing is 3 feet on the triangle, *i.e.*, approximately 5,000 plants per acre The plants used are of two kinds (1) tops ("matana") cut from mature plants and (2) suckers ("sulisuli"). The former are best allowed to dry out for a few days to develop roots before being planted, while the

latter may be planted the same day as they are lifted. The plants are graded for size and are set on the bottom of the holes and a small amount of earth pressed about the base Small suckers may also be planted out in nursery beds until they are big enough to be transplanted: and are frequently planted closely on the banks or bunds of dalo gardens.

If a spade is used, an open hole 12"–16" deep and 6" wide is made and the plant set in the bottom—the hole being left open. For hillside planting either the stick or fork may used to loosen the soil sufficiently to allow the plants to be set in the hills. This method of shallow planting is rapid but results in small tubers being formed. In the irrigated terraces the beds are forked over—the water turned in and then dalo plants set by hand in the soft mud. All the varieties mentioned except " Tausala " may be grown in this way and the latter variety is sometimes planted on the banks of the terrace.

*Cultivation.*—Early clean weeding with hoe or knife is essential and the first weeding should be made three or four weeks after planting, especially in the wet zone. If the preparation of the land has been thorough the first weeding may be dealyed. In flat land the digging up of para grass with a fork is recommended. Two or three weedings may be required up to six or seven months, after which no further weeding should be done. At each weeding any debris or loose earth is removed from the holes in which the plants are growing.

As the plants approach maturity the leaves fall away and the crop is ready to dig at from 7–12 months according to variety and method of planting.

Early maturing varieties are " Tausala " and its variants, " Kurokece," " Sisiwa " (7-9 months) while " Samoa," especially in damp soil, may take 12 months to mature. Shallow planting on hill-slopes results in an early crop of small roots.

*Harvesting and yield.*—Once the crop is mature it should be lifted without delay, at least within four weeks. This is the best done with aid of a digging stick and care is necessary to avoid bruising the roots. The size of the tubers varies from the small even rounded ones of " Mumu " to the large elongated ones of " Dalo Samoa " which may reach a length of 3 feet and a girth of 24 inches. The average weight of good dalo is five pounds with tops and these are the best for market purposes. There are thus about 500 to 600 roots to the ton.

The yield per acre averages some 4,500 roots or 8 tons valued at from £40 to £60. The present standard price is 1d. per lb.

Dalo cannot be stored for any length of time and should be used within six days of being lifted.

*Uses.*—Dalo tubers provide the staple article of diet of a large number of people in the Colony—and may be eaten after being boiled, baked or roasted.

Dalo leaves (" rourou ") are an excellent substitute for spinach and are usually boiled with coconut milk. In Rewa, the leaves are used to wrap up shrimps for steaming and are eaten with them.

The leaf petiole (" tabana ") is peeled and cut into small pieces—and may be boiled to provide a food known as " Baba " or parboiled by being immersed in boiling water for a few minutes to make " Baseisei " which is garnished with lemon juice.

For making the sweetmeat known as " Dalo vakalolo " the variety " Vavai " only is used. Small unpeeled roots are boiled or steamed then peeled and pounded up and made into balls which are served with coconut milk and sugar.

All varieties may be used to prepare " Dalo yaca " in which the raw tubers are grated and the material wrapped in a Banana or *Dræcena* leaf and baked. This may be eaten with or without coconut milk.

Dalo is an excellent and highly nutritious carbohydrate food of fair fat content and contains good quality protein.

## COPRA NOTES.

### 1. COPRA PRICES.

The following table shows the average London prices per ton of fair, merchantable, sun dried F.M.S. copra in four different copra-producing countries, and should prove of interest to readers in this Colony as indicative of the intrinsic value of our product compared with that of the countries specified:—

| Year. | Straits Settlements. | Philippines. | New Guinea. | Fiji. |
|---|---|---|---|---|
| | £ s. d. | £ s. d. | £ s. d. | £ s. d. |
| 1934 .. .. .. | 9 6 0 | 7 19 10 | 8 13 5 | 8 1 5 |
| 1935 .. .. .. | 12 17 5 | 11 17 7 | 12 9 0 | 11 7 0 |
| 1936 .. .. .. | 15 13 4 | 14 14 4 | 15 6 3 | 14 10 0 |
| 1937 .. .. .. | 17 4 9 | 16 6 0 | 16 17 8 | 16 5 2 |
| 1938 .. .. .. | 10 9 7 | 9 11 3 | 10 3 11 | 9 8 0 |
| Totals .. | 65 11 1 | 60 9 0 | 63 10 3 | 59 11 7 |
| Averages .. | 13 2 2 | 12 1 10 | 12 14 1 | 11 18 4 |

Thus, the table shows that during the last five years when depressed prices were ruling, Fiji copra (F.M.S.) was valued at an average of 15s. 9d. per ton less than Rabaul copra and £1 3s. 10d. less than Malayan copra.

These are material differences in these days of low prices and clearly indicate that there is need for much improvement in Fiji's product.

—H.W.J.

### 2. OIL-CONTENT OF COPRA.

Poor quality copra, by the time it has dried out *en route* to the worlds' markets, may have a higher oil content than good copra. In good, correctly dried copra, very little loss in weight is experienced because it is not attacked by moulds, which cause much disintegration of the surface layers of badly dried copra, which later breaks down to dust (which is lost), leaving the copra quite thin. It is well known that the oil-content of copra increases towards the rind of the meat, as compared with the layers more remote from the rind, and it is because these latter layers are often lost to an appreciable extent in bad copra that the remaining copra, being thin and mainly consisting of a narrow margin near the rind, shows a high percentage of oil.

It is, however, also well known that a given number of ripe nuts will, if correctly and thoroughly dried, give very appreciably more copra than if the same number of nuts is carelessly, or improperly dried. Differences of 50 per cent. or more, may easily be realised in the weights of copra derived by good, as compared with bad drying, and these differences more than balance differences in oil-content between good and bad copra. Hence, good copra, which loses little in storage or in transit, gives a much bigger yield of oil per acre of plantation than is possible from bad copra.

This aspect of copra production (oil-production per acre) is frequently overlooked in Fiji where too much dependence is till placed on sun drying, so that production is frequently materially reduced by direct losses in manufacture, due to the fickle nature of our climate. —H.W.J.

### 3. DIGESTIBILITY OF COCONUT OIL.

" Recent work on the rate of digestion of fats has been published by Miss Hartwell of King's College, London, (Biochem. Jour. 1938, 32, 462), which seems to favour coconut oil in this respect. The rate of digestion of various fats by pancreatic lipase was measured, the fat being prepared in the form of ' reconstituted cream ' so that the fat was in the form of minute globules and the conditions comparable with those of actual digestion in the organism. The results are of particular interest and some of the conclusions worth quoting *in extenso*:—

" Coconut oil was digested more rapidly than any other fat including butter. Almond oil, cocoa butter, groundnut oil, bacon fat, beef fat, oleostearine, cod liver oil, cotton seed oil, lard, mutton fat, olive oil, premier jus, soya bean oil, hardened whale oil and hardened groundnut oil, were digested at a much slower rate than butter and all at approximately the same rate.

" It seems possible that if margarine contain this fat (coconut oil) it may be more rapidly digested than butter. Coconut oil ' may prove a more valuable food than has hitherto been supposed '."

—" Coconut Industries," Ceylon, June, 1939, page 106.

### 4. UNIFORMITY OF COPRA.

One of the chief defects of Fiji copra is its lack of uniformity. This defect is due to several causes, which are certainly capable of being remedied on any well organised estate, however small.

One of the chief causes (there are several) of lack of uniformity is that collecting rounds are often irregular and of insufficient frequency and hence result in a collection of nuts in varying stages of maturity—immature, mature, over ripe, germinated, advanced state of germination, &c. All these nuts are bulked together, instead of separating immature and germinated nuts from those which approximate to the correct stage of ripeness. The meat from such a mixed lot of nuts, cannot, even under the best possible drying conditions, produce copra of uniform quality of even moderately good grade, and the task of picking it over after curing is too expensive on estates that employ labour.

The obvious remedy, if more regular picking rounds cannot be adopted, is to grade the nuts into two classes when splitting them, (*a*) good ripe nuts and (*b*) all others (immature, " varas," &c.), before cutting out the meat and then to dry the meat from each class separately. In bagging, the copra should be graded.

It may be mentioned that in all the best copra producing countries, the nuts are actually cut off the palms as soon as they are ripe, and often rather a little before the dead ripe stage, so that copra production may be at its optimum, both as regards quantity and quality. In wet countries like Fiji and Malaya, the ripe nuts will frequently have started to germinate before they fall from the palms. In Fiji, after nuts have fallen, they are often permitted to lie on the ground for two to three months before being collected for copra curing. An appreciable percentage of such nuts will not only have germinated, but will have produced shoots of varying lengths; such " vara " nuts, if the haustorium (apple) exceeds two inches in diameter

cannot produce first quality copra. Also, a material loss in the weight of meat occurs in such nuts, causing a direct loss to the owner. In Malaya the ripe nuts are cut from the palms by means of a curved knife fixed at the end of a long bamboo pole—sometimes 70 to 80 feet long, or even longer. The optimum picking round is regarded as once in six weeks.

Incidentally, the method of gouging out "green meat," which is customary in Fiji, is not in vogue in the large copra producing countries, this method being regarded as slovenly, for the following reasons:—

(*a*) it is wasteful of meat—a small percentage is always lost as chips, as well as oil on the knife and hands of the cutter;
(*b*) the meat generally becomes dirty and mixed with extraneous matter, sand, pebbles, débris, &c.;
(*c*) the copra is produced in small pieces—even if the small pieces are of good quality, a pile of small copra will have a dirty appearance;
(*d*) the actual amount of labour exerted is more than is required for husking and splitting the nut (this is confirmed by Sampson, the greatest South Indian copra authority);
(*e*) the resulting copra never looks as good in a heap as copra produced by the Oriental method (husking and splitting and drying in the shell);
(*f*) further loss of more chips occurs in the drying process;
(*g*) frequently, such copra is permitted to sweat in sacks before drying can be started—such copra is never likely to be white;
(*h*) the method (where kilns are used) is regarded as uneconomical of fuel, largely because of transport costs.
(*i*) further losses occur as sweepings at bagging;
(*j*) such bagged copra lacks ventilation, which tends to cause an increase in free fatty acid, unless the copra is very dry.

—H.W.J.

## 5. GREEN COPRA.

The local practice of cutting and selling "green copra" is a pernicious one and should be discouraged everywhere, especially wherever it is abused, as is frequently the case; moreover, with the expenditure of very little labour, the Fijian would obtain far better value for his product if he dried it himself and sold it as dry copra. Such dry copra could be kept in store for considerable periods if local storekeeper buyers did not offer reasonable prices; whereas with green copra, sales must be effected quickly and "a take it (the money) or leave it attitude" is often adopted by the storekeeper to his own particular advantage.

In 1937, there were only five licensed "green copra" buyers. There are now 168, and each licensee's premises and copra are inspected three times annually, so that the tenets of section 9 of the Copra Ordinance will gradually be impressed on the licensees. Thus, it is hoped that the standard of "green copra" will gradually be improved.

The "tabu" often placed on copra making under communal conditions is also a practice which should be terminated since it is definitely wasteful of copra, and is, moreover, detrimental to the production of good copra. Such a "tabu" results in a large percentage of germinated and sprouted nuts and such nuts show a material loss in the weight of fresh meat (and copra) compared with nuts in the proper stage of ripeness. The loss in copra may frequently approach 50 per cent. This matter has been referred to the Native Department for early consideration.

—H.W.J.

### 6. COPRA DRYING BY FIJIANS.

It has been stated that copra production by natives at present prices is unremunerative.

Under estate conditions the native worker is generally expected to cut out 560 lb of "green copra" per day, but when working for himself, it is doubtful if the native cuts out more than 2 cwt (224 lb) in a day.

Assuming that he does cut out 224 lb "green copra," he sells this to the local storekeeper at 1s. 6d. per cwt. (112 lb), so that for his day's work he is rewarded by a return of 3s. This should be considered a good wage for a Fijian working under "home" conditions. Thus, the return to the farmer is £3 per ton of copra at present prices (August, 1939), and if he produces half a ton monthly, this return should be sufficient for the purchase of his essential needs. On the other hand, if the Fijian collects his own nuts, and cures his own copra, his monetary return can be doubled, though he will have to spend a part of several days attending to the drying process.

By using a native kiln such as is advocated by the Department of Agriculture, and which may be built economically out of bush materials in existing plantations, a native can collect enough nuts (1,200–1,500) to produce a quarter of a ton of copra, husk and split the nuts and dry the copra (¼ ton dry) in five full days' labour, made up as follows:—

First day.—Collect 1,200–1,500 ripe nuts.

Second day.—Husk 1,200—1,500 nuts.

Third day.—Split and drain 1,200–1,500 nuts, light the shell fire then put the split nuts on the kiln—about three hours work, including occasional attention to the fire, and one turning over of the drying nuts.

Fourth day.—Attention to firing, and one turning over of the drying nuts in shell—about two hours' work and numerous other jobs can be done on the same day.

Fifth day.—Same as the fourth day, except that loose shells should be removed from the kiln—about 2–3 hours.

Sixth day.—Same as the fifth day.

Thus, with comparatively easy work (once the native has become accustomed to the husking), and counting the third, fourth, fifth and sixth days as half days, and allowing two additional half days for turning over and bagging the dry copra, one-quarter of a ton of dry copra can be produced in five full working days, or, say, one week.

Thus, within a week, during which he can do many other odd jobs, a Fijian can easily prepare a quarter of a ton of copra of good quality, for which his return is at present not less than 15s. This is equivalent to £4 per month, which is about the average wage earned by a Fijian as a wage earner in Suva. The farmer living in the country can produce, not only a quarter of a ton of copra within a week, but he also produces all his own food—dalo, kumalas, fish, &c., and lives in his own house, so that the farmer is really in a very much better position (financially and otherwise) than the wage earner living in a rented room in Suva. He also gets more nutritious food and enjoys many home conforts compared with the wage earner.

Copra prices are never likely to equal those in vogue ten years ago, under normal conditions, but the above figures show that even at present prices, copra gives a good return to the Fijian. Therefore, he should be encouraged to plant more coconuts whenever conditions are good, and to attend to them as a means of supplying cash for his necessary purchases, which need not, and should not, be many.

Life on the land for the average Fijian provides much more solid comfort, better housing, better food, better family conditions and a better financial position than life as a wage earner in town, and hence, the Fijian race is better served by life in the country, than in the towns, and therefore, every assistance should be given to those anxious to settle on the land as peasant farmers.

H.W.J.

### 7.—COCONUT HUSKING.

#### 100 NUTS IN 20 MINUTES.

At the recent Fiji Agricultural Show, the Coconut Husking Competition aroused considerable interest.

There were 20 Fijian competitors, and each man was given 100 coconuts to husk. Most of the competitors finished their 100 nuts within 20 minutes, but the winner's time was 18 minutes 8 seconds, while the second and third prize men also finished in less than 19 minutes.

The three winners, and most of the others, were boys employed in and around Suva, and had no practice at husking, and hence their times are quite creditable.

Many of the nuts were not particularly dry, which made the work the more difficult, so that the competition clearly indicates that husking is not such a difficult job for a Fijian as has been maintained in certain circles.

Three special prizes were donated by Dr. H. W. Jack, Director of Agriculture.

The Hon. Mr. T. W. A. Barker was timekeeper for the competition.

(From *Fiji Times & Herald.*)

## REVIEW.

### THE FIG MOTH ON STORED COPRA.

The issues for September, 1938 (Vol..9, No. 3) and October, 1939, mentioned the harmful caterpillars of the fig moth *Ephestia cautella* Wlk. and the suggested treatment based on Malayan experience, hinged on the relative unattractiveness of good copra for the development of the grubs.

A recent issue of an agricultural journal* gives some control measures advocated in New Guinea where this pest also occurs.

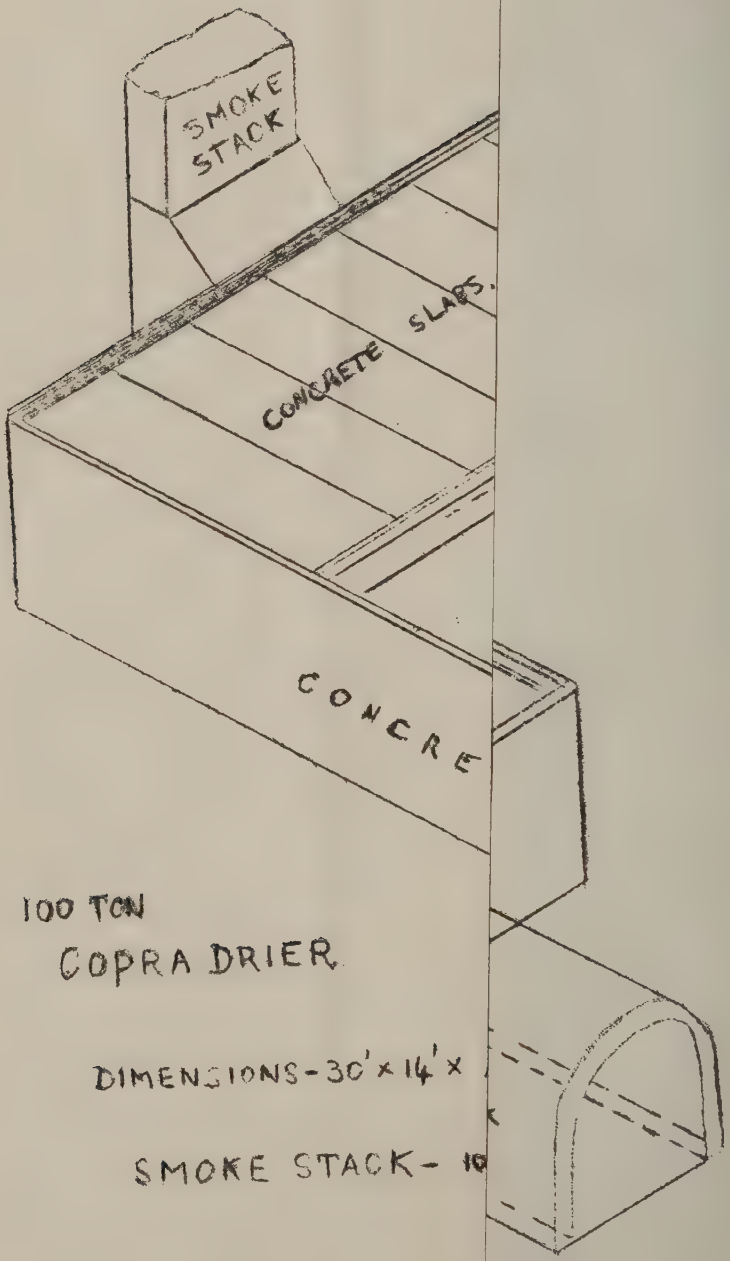
The following are the chief points to consider in reducing the infestation to a minimum, bearing in mind that well-dried copra provides a poor medium for the caterpillars:—

(1) Heap and turn over the copra daily for several days after drying prior to bagging so as to obviate sweating in the sacks.
(2) Store the copra in weather-proof sheds and avoid wetting it by rain or salt water from leaky boats when loading.
(3) Minimum storage on the plantation prior to shipping.
(4) Avoid storing rice in the same or adjacent sheds to that used for copra as the former is usually heavily infested with *Ephestia.*
(5) Avoid final bagging in sacks previously used for carrying "green" copra or such cereals as rice or "sharps."
(6) Keep walls and floor of all sheds clean and spray with kerosene.

It is realised that with copra fetching only £5 in Suva all unnecessary expenses must be cut down but, as the reviewer is aware, the damage done to copra is causing some concern in Australia and complaints are being passed on to the exporters from certain Pacific islands who are faced with the problem of checking the shipping of copra infested with this caterpillar.

* Froggatt, J. L., & Moody, F. O., 1939. *New Guinea Agricultural Gaz.*, Vol. 5, No. 2.

—R.J.A.W.L.




100 TON
COPRA DRIER

DIMENSIONS - 30' x 14' x

SMOKE STACK - 10

## SMALL ESTATE COPRA DRIER.

By
H. W. JACK, M.B.E., D.Sc., B.A.,
Director of Agriculture, Fiji.

In order to satisfy an expressed desire amongst small estate producers for some form of inexpensive copra drier, this brief description of a platform drier may be found useful.

This form of drier (*See* diagramatic sketch), which is used on some large estates in the Orient, appears suitable for the drying of copra under existing conditions, which involve the splitting of whole ripe fruits and the gouging out of the meat thus exposed.

The drier, as its name implies, is merely a hot drying floor, the heat being maintained by a fire located at one end and kept permanently alight—husks, shells or timber, or any readily available, inexpensive fuel may be used.

A fire stop prevents the fire from extending too far under the floor and simple baffle plates are placed beneath the floor in order to ensure adequate circulation of the hot air.

The attached plan is self-explanatory and indicates concrete structure throughout, except for the baffle plates and the smoke stack. Such a kiln would be most satisfactory, and would require the following materials:—

| | |
|---|---|
| Cement .. .. .. .. | 29 barrels. |
| No. 8 fencing wire .. .. .. | 1½ cwt. |
| Sand .. .. .. .. .. | 9 cubic yards. |
| Crushed stone. .. .. .. | 17 cubic yards. |
| ½in. diameter round bars 15ft. long | 12 bars, or 1 cwt. |
| Smoke stacks .. .. .. | 1 or 2 sheets of corrugated iron. |
| Baffle plates .. .. .. .. | 4, 8ft. sheets of corrugated iron cut in half. |

In Suva, these materials would cost approximately £35 at the moment except that no account is taken of sand and crushed stone. However, in many instances, it should be possible to improvise and thus eliminate the use of new materials as much as possible so as to reduce costs materially.

Thus, although the floor should made be of cement, or of cement slabs, the walls may be made of old timber, tree trunks, corrugated iron walled up with earth, rocks plastered with mud, or any other handy materials. The posts and beams may be made of rough hardwood available in the bush, or old posts or iron, while old corrugated iron would do for the baffle plates and smoke stack.

Moreover, if the kiln is built on the side of a hill, excavation should save the use of materials in forming one side or more of the kiln, but care should be taken to assure that rainwater is carried away from the kiln by adequate drainage.

Over the kiln, a native type of house is built to eliminate rain and cool winds. The house is provided with one door and one window (push-out) at the end remote from the door, while one ventilator is situated at each end as near the apex of the roof as possible. The housing should be large enough to provide storage space for dry copra for some days before bagging and a separate hut should be utilised to keep a stock of dry fuel.

The fire is kept permanently alight, and drying is extended over four days, as a rule, the cut out " green " meat being spread so that its depth does not exceed 2 inches especially on the first day of drying.

The drying floor might be divided into four compartments by 2in. x 1in. laths so as to allow a little more space for the first day's drying than for subsequent drying.

It is considered that in the construction of this simple type of kiln much already available material can be utilised and that the work involved can readily be performed by estate labour under the supervision of the Manager.

The kiln is suitable to the local but somewhat wasteful method of cutting out " green " meat from split whole fruits and it is effective in producing good copra in the East but is not utilised much compared with the " Ceylon " type of kiln which involves husking and spliting the nuts and depends on the direct smokeless heat of cupped rows of burning shells.

Full sized working plans will be made available to interested planters on application to the Department of Agriculture through the local Agricultural Officers.

## THE AGRICULTURAL SHOW.

The Annual Show, which was held on the 16th October, 1939, provided an opportunity for the Department of Agriculture to display some of the results of the labours of the staff and some of the potentialities of the Colony, and, hence, an attractive exhibit was staged.

The general verdict of the public indicated that this year's agricultural display was the best yet seen in the Colony, and this verdict reflects much credit on all officers of the Department, native as well as European, who combined harmoniously to make the Show a success.

The following extracts from the *Fiji Times & Herald* issued on the 17th October, 1939, are of interest in recording the public opinion of the Agricultural section of the Show:—

> " This year the agricultural officers of the various districts and the Department's officers generally, appear to have made a special effort to make their contribution to the Show as representative as possible and the result is indeed a very versatile and interesting display.
>
> " The various provincial stands reflect the growing initiative and enterprise of the Fijians, and there is no doubt that the attendants at the various native exhibits took no mean pride in the results of their labours. This is a very healthy influence, and perhaps one of the features of the Show which most strongly justifies its existence. Of particular interest to town residents were the fine displays of vegetables such as cabbage and cauliflower, illustrating the fact that this form of production has improved considerably in Fiji during the past two or three years.
>
> " Most interesting in view of the efforts being made to encourage agriculture among the Fijian people was a map of Viti Levu with coloured flags showing the exempted Fijians and their location. These are men exempted from community duties and pursuing their individual existence as independent farmers. This map dealt with the Central District alone but it was stated that there are over 900 of these men who have been assisted by the Department to strike out for themselves. This, perhaps, is one of the most significant developments in Fiji in recent years concerning the native race."

The Sir Maynard Hedstrom trophy for the best District or Provincial exhibit was awarded to the Northern District, which tastefully displayed a wide variety of good quality produce which included copra, coconuts, rice, padi, yaqona, sugar cane, cocoa pods, coffee berries, cowpeas, soya beans, annatto, pumpkins, walking-sticks, bananas, timbers, tobacco, kauri gum, dhall, ghee, coconut oil, turmeric, vetiver grass, yams, dalo, " tapa " cloth, mats, " Qai " (Fijian sugar), cotton, pineapples, tomatoes, eggs, soap,

kumalas, ginger, arrowroot, derris, cucumber, soursop, mango and various curios.

There were five competing Districts for this handsome trophy, and all displayed highly meritorious collections of good produce, reflecting much keenness and proving of considerable interest to the public.

The copra industry was represented by a fine display of good quality copra, together with a model of the smallholder's kiln, and a model of 100 ton smallplanters' platform drier. In addition, a coconut husking competition drew 20 competitors and an appreciative audience.

A model peasant's farm, cleverly constructed by the Natabua Teachers' Training School, indicative of the general type of mixed farm which the Department is now advocating for smallholders, proved an added attraction to the Show and should have a useful educational value.

Diagrams and mounted specimens of various cottons represented the lines along which efforts are being made to stimulate cotton cultivation, while tobacco varietal experimental work was displayed in a collection of " hands " of the better types which have been under experiment.

The manufacture of cheroots and cigars was demonstrated by a display of these products and of blocks of " stick " tobacco; also the operation by Fijians of a twisting machine making " rope " tobacco proved attractive.

Research work in progress with rice, dalo (taro), kumalas (sweet potatoes), beans, Irish potatoes, broom millett, sagu, bananas and banana disease control was also well represented by varietal collections of high quality. Special mention in this report must be made of the pure line selection work on rice whereby heavy yielding types are isolated, multiplied and distributed for general cultivation for the purpose of increasing the crop returns derived from the cultivation of this important cereal. Although this work has only been in progress for a few years, the results already gained are indicative of a high degree of success. More than a dozen varieties of Irish potatoes, dalo, kumalas, &c., were staged, all of which are undergoing exhaustive trials as to their suitability for varying conditions.

A display of oils, meals, starches, &c., produced locally, included chaulmoogra oil, which is so useful in the treatment of leprosy, cocbnuts, soya, cotton seed, citronella, nutmeg, dilo and candlenut oils.

Also of interest was wholemeal bread produced from locally-milled imported wheat and made from the same meal to which had been added 15 per cent. of maize meal as an improvement to the diet. The bread was baked in the local gaol, and indicates lines along which the staple diet of the European and others can be improved.

Illustrative of progress in animal husbandry, a sanitary pig-sty containing four young pure-bred pigs was instructive, while a combined chicken coop-brooder containing live pure-bred incubator chicks demonstrated a method of control of coccidiosis, worm parasites and fowl-pox, which cause such heavy depredations in poultry stock.

A collection of local pasture grasses and other plants and of specimens of pathological conditions of animals also proved attractive, and it may be mentioned that the poultry stock exhibited by the Department was of a high order and created favourable comment.

The Entomological Division staged exhibits illustrative of methods of controlling pests of stored grains, chiefly rice and maize, and also for the control of cut worms, including specimens of the moths and caterpillars and photographs of damaged areas. Live toads and tadpoles were also in view as effective controllers of cut worms.

The Show was well attended and considerable interest was apparent.

## LIST OF PLANTS INTRODUCED TO FIJI BY R. B. HOWARD AND W. L. WALLACE

By

B. E. V. PARHAM, M.A.,

Agricultural Officer, South.

During the past twenty years, Messrs. R. B. Howard and W. L. Wallace have co-operated in the introduction of economic and ornamental plants, many of which have been established on the latter's property at the Island of Tova, Ba Province.

A record of such introductions is valuable for several reasons and the results obtained may be of considerable service to others interested in the establishment of exotic species in Fiji.

The list contains 46 species of timber, fruit and ornamental trees, shrubs, grasses and vegetable crop plants and is arranged alphabetically, the botanical family being given in brackets followed by the common name. Short descriptive notes are added.

From a botanical point of view the list is of considerable interest, the 46 species belonging to 24 families and 33 genera. There are 39 trees, 2 palms, 1 shrub and 4 herbs and the countries of origin are as follows:—Australia, 30; Central America, 6; China and Japan, 2; Southern Europe, 2; and 1 each from India, tropical Asia, Africa and Madagascar; uncertain, 2.

The principal families represented are Myrtaceæ, 11 species; Leguminosæ, 6; Pinaceæ, 3; Gramineæ, 3; Proteaceæ, Sterculiaceæ and Palmæ, 2 species each.

*Uses.*—All but three of the plants are of economic interest and their uses may be classified as follows:—Timber trees, 22; fruit trees, 9; fodder plants, 7; vegetables, 2; oil plants, 1; fibres 1 and sugar palm, 1. Forty species are ornamental, three only without also economic value.

*Results.*—The results achieved with these introductions are indicated by the notes supplied by R. B. Howard and these may be summarized as follows: Growth good, 39 (85 per cent.); growth poor, 4 (9 per cent.); doubtful, 1; and seedlings only 2.

Among the timber trees are some of the most important timber species of Australia, viz., hoop pine and *Eucalyptus* spp.; mahogany, silky oak, quondong and log wood are also worthy of note in this connection.

Among fodder plants the success reported with the algaroba and Carob bean is of great interest and the grasses—Russell River and Bahia—are useful additions to the introduced grasses of the Colony.

Of the fruit trees, the Queensland nut, the Leichhardt tree, Davidson's plum, the Burdekin plum and the "Wongai" are noteworthy as the first records of these species as fruiting in Fiji. The selected varieties of pomegranate and the quinine berry are also of considerable interest. The jujube, the Indian cherry and the loquat have been recorded before; the first two have now become practically naturalized in a number of places.

Other economic species are the tea tree which provides a useful bark and an important oil—and the Raffia palm, the source of a useful fibre.

Reference may also be made to the species which so far as can be ascertained are here recorded for the first time for Fiji. There are 29 in number and are indicated in the list by an asterisk (*). Of these the most interesting appear to be the tree of splendour (*Sterculia trichosiphon*), the white cypress pine, the blue bush, dasheen, Rusital and Raffia palms, tea tree, the "wongai," quinine berry, native willow and the Leichhardt tree.

The list is as follows:—

1. **Acacia pendula*, A. Cunn. (Leguminosæ). Myall.—Introduced in 1921, only one or two trees, growth not too good. A handsome tree—the wood fragrant, hard and close-grained.

2. *Araucaria Bidwillii*, Hook. Bunya pine.—Introduced by Mr. Howard in 1923. Does well; trees at Sigatoka, now 15–20 feet high. A native of South East Queensland, a large symmetrical tree reaching 100–150 feet in height, the unbranched stems being sometimes 80 feet.

The large fruit cones are rather like pineapples in form and the egg-shaped seeds weighing 30 to the pound are much valued for food by the aborigines. There are a large number of seeds in one cone. The seeds are sweet before being perfectly ripe and are then like roasted chestnuts in flavour.

The wood is very strong, almost white, even-grained, polishes well and works easily and is useful for indoor work.

3. *A. Cunninghamii*, Ait. "Hoop pine."—Introduced 1920, several doing farily well (1939). A magnificent tree from New South Wales and Queensland and highlands of New Guinea. Height, 150 feet; diameter often 5 feet, height of trunk up to 90 feet. The timber from this tree is of great commercial importance in Australia—strong and durable when dry.

4. *A. excelsa*, Norfolk Is. Pine.—Introduced 1933; trees of poor spindly growth. A beautiful symmetrical tree with regular whorls of horizontal spreading branches attaining a great height.

5. **Brachychiton (Sterculia) populnea* G. Don. (Sterculiaceæ) "Kurrajong."—Introduced 1918; showing poor growth (1939). A tree 20–60 feet high from Victoria to Queensland, a fodder tree for cattle and sheep in times of drought.

6. **Sterculia. (B). trichosiphon*, Benth. (Sterculiaceæ) Bottle tree.—Introduced 1920—growing well. A native of New South Wales and Queensland—known also as broad-leaved flame tree and tree of splendour on account of its deep-red flowers.

7. **Callitris glauca*, White Cypress pine or Murray pine.—Introduced 1920—several varieties doing well. From the coastal ranges of Australia; a tree up to 100 feet in height with greenish blue foliage. The wood has a variety of shades and is used for interior wall decoration and for picture frames, panelling, &c.

8. **Casuarina torulosa*, Ait. (Casuarinaceæ) Mountain or red oak.—Introduced 1927; does well; large trees. From Queensland and New South Wales, a tree 50 feet high, favouring moist soils. Timber very good for shingles, walking-sticks, &c., and for fuel.

9. *Cassia fistula*, Linn. (Leguminosæ).—Introduced 1917; does very well but does not produce seeds in Fiji. Golden shower or Indian laburnum, an ornamental tree from tropical Asia. The bark is used for tanning and the pulp of the fruits are used as an aperient. It is also grown as a shade tree.

10. **Castanospermum australe*, A. Cunn. (Leguminosæ). Bean tree, black bean or Moreton Bay chestnut.—Introduced 1923; growth not very good. A handsome tree from Queensland and New South Wales with glossy bark green pinnate leaves, yellow-red flowers and large seed pods containing three to five glossy brown seed like chestnuts which are cooked and eaten by aborigines but are reputed to be poisonous to horses and cattle as they contain saponin. The timber ranks high among Australian timbers for cabinet work.

11. *Ceratonia siliqua*, Linn. (Leguminosæ). Carbobbean, locust bean or St. John's bread.—Introduced 1924. Two or three trees strong and healthy. A tree from South Europe and Asia Minor whence the fruit are exported for stock feed. The sweet sugary pods are a valuable fattening and nutritious feed for cattle. The tree is slow growing but is said to continue productive

for over 100 years. A single tree may produce 2 to 3 cwt. of fruit a year. Best result obtained by grafting selected varieties.

12. **Chenopodium auricomum*, Lindl. (Chenopodiaceæ) Bluebush.—Introduced 1939; seedlings only. Pioneers used the green leaves for spinach and the dried leaves as a substitute for tea. (R.B.H.).

13. **Colocasia esculenta*, Schott. (Araceæ) Dasheen.—Introduced from America 1932 and doing well.

14. **Corypha elata* (Palmæ) Rusital Palm.—Introduced 1924; healthy but very slow growing. A tall, stout, erect palm with large fan-shaped leaves. At the age of 30 35 years the trunk yields, from an incision made just below the terminal bud, a juice rich in sugar. From 250-300 lb of sugar can be obtained from a single tree in a season.

15. **Davidsonia pruriens*, F.V.M. (Saxifragaceæ).—Introduced 1922; two or three trees doing fairly well. A tree 30–40 feet high endemic to Queensland and known as the Queensland itch tree on account of its hairy covering, and Davidson's plum because of its nearly globular purple fruit 2½ inches long which has a sharp acid flavour.

16. *Elæocarpus grandis*, F.V.M. (Elæocarpaceæ) Blue quandong.—Introduced 1918; flourishing and fruiting. A tree often exceeding 100 feet in height, from the coasts of Queensland and New South Wales. Also known as blue fig, New South Wales bracelet tree (on account of decorative berries). The tree provides a valuable light-weight timber which is used for joinery, cabinet work and interior fittings.

17. *Eriobotrya japonica*, Lindl. (Rosaceæ) Loquat.—Introduced 1920; doing reasonably well. A small tree from China and Japan producing a small pear-shaped, yellow fruit with a sweet acid flavour. The dingy white flowers are fragrant.

*Eucalyptus* spp. (Myrtaceæ).—All doing well as follows:—

18. **Eucalyptus calophylla*, Red gum.—Introduced 1918; West Australia "marri" with handsome leaves and a beautiful red flower in two varieties.

19. **Euc. corymbosa*, Sm. Bloodwood.—Introduced 1918. A tree 80–100 feet high from North Australia, Queensland and New South Wales with a durable cross-grained timber.

20. **Euc. citriodora*, Hook. Lemon-scented gum.—Introduced 1917. A fairly tall tree with smooth white bark and long olive-green leaves which when crushed have a sweet lemon scent. Widely planted for street decoration.

21. **Eucalyptus crebra*, F.V.M. Narrow-leaf iron-bark.—Introduced 1924. One of the best and most widely distributed of all the iron barks, growing well in dry country. Timber used for sleepers, girders, bridges and wharf construction.

22. **Euc. leptophleba*, F.V.M., Box-gum.—Introduced 1938. A moderate sized or large tree with rather wrinkled, dark rugged bark. The bark of this tree is easily stripped, and was largely used by the early settlers for roofing, walls and other building purposes; it is very durable. The timber of this tree has a very interlocked grain, and is difficult to split.

23. **Euc. maculata*, Hook, Spotted gum.—Introduced 1918. An ornamental tree from all parts of Australia, 100–150 feet in height with large glossy leaves a foot long. Timber strong and much used by shipwrights and house-builders.

24. **Euc. paniculata*, Smith, Grey Iron bark.—Introduced 1920. A tree from coastal districts of Victoria, New South Wales and Queensland reaching 150 feet in height. The timber has great strength and durability and has been planted extensively in South Africa for use as railway sleepers.

25. **Euc. risinifera*, Sm., Stringy Bark.—Introduced 1918; known also as red mahogany this is one of the largest trees growing on the coast of New South Wales to Queensland, reaching 150 feet in height with a diameter up to six feet. Timber is strong and durable and used for building purposes.

26. **Euc. staigeriana*, F.V.M., Lemon-scented iron-bark.—A small tree with a dark rugged irregularly fissured bark and glaucous foliage.

27. **Euc. tereticornis*, Sm., Red iron-bark.—Introduced 1924. The forest red gum of New South Wales, Queensland and Victoria is a tall tree with smooth bark. It grows in dry country and has done well in South Aftica. The timber is hard, red with straight grain and suitable for furniture as well as for constructional work.

28. *Flacourtia jangomas*, Rausch ( = F. *cataphracta* Willd.) (Flacourtiaceæ), Indian Cherry.—Introduced 1918; now florescent and fruiting. A small thorny tree from North Indian and Malaya, producing round berries of the size or large cherries, purlish or deep red when ripe.

29. *Grevillea robusta*, R.Br., (Proteaceæ) Silky Oak.—Introduced 1918. Fairly large trees, doing well. A native of Queensland and New South Wales this tree is much favoured for street planting, parks, &c. It has been grown as a shade tree in coffee and tea plantations. The wood is moderately hard and easily worked and is used for cabinet making.

30. *Hæmatoxylon campechianum*, Linn. (Leguminosæ), Logwood.—Introduced 1922. Large trees now doing well—florescent. The heartwood of this tree which is a native of Central America and West Indies, contains a red dye which has a small but restricted market. The tree is also used as a hedge plant.

31. **Hyparrhebia rufus* (Gramineæ).—Introduced from America 1938; growing strongly.

32. *Kegelia pinnata* (Bignoniaceæ), Sausage tree.—Introduced 1933; one or two plants doing well. A moderate-sized spreading tree of Tropical West Africa with remarkable oblong gourd-like fruits, suspended by long cord-like stalks, 3–5 feet in length.

33. *Macadamia ternifolia* F. Muell. (Proteaceæ), Queensland nut.—Introduced 1918 now fruiting, growing strongly. This is a medium-sized tree up to 60 feet in height, native of New South Wales and South Queensland. The nuts are edible and of excellent flavour and food value.

34. **Melaleuca leucadendron*, Linn. (Myrtaceæ), Tea tree.—Introduced from Australia 1920. Two or three types doing remarkably well. The bark was largely used by pioneers for roofing and other building purposes. It is very durable and can be stripped off in very large sheets. The aborigines use it in lieu of a blanket. The leaves and fruit yield an important oil—Cajeput oil, (100 lb of leaves said to yield 5 oz. of oil) which is as useful as *Eucalyptus* oil for medicinal purposes and more fragrant in odour.

35. *Mimusops Browniana*, Benth. (Sapotaceæ) "Wongai" (Torres Strait).—Introduced 1919; trees flourishing; now fruiting. This is a tree from the east coast of Queensland and is sometimes called Queensland ebony, becuase of the dark colour of its wood which is black, and very heavy.

36. **Paspalum notatum* (Gramineæ), Bahia grass.—Introduced from America 1938, but germination not successful.

37. **Paspalum galmarra*, Bailey, (Gramineæ), Russell River grass.—Introduced 1922; is a prolific seeder and has an abnormal carrying capacity It has been widely distributed throughout Viti Levu and its nutritional value is equal to *Paspalum dilatatum*. Well established at Tailevu.

38. **Petalostigma quadriloculare*, F. von. Muell. (Euphorbiaceæ), Quinine berry.—Introduced 1938; seedlings growing. Known also as bitter bark, emu apple or wild quince, this is a moderate-sized tree of New South Wales and coastal districts of Queensland. The pretty white flowers are followed by orange-coloured fluted berries as large as cherries and very bitter. The timber is hard and close-grained. Dyes have been obtained from the bark which is also used in a tonic mixture.

39. **Pittosporum phillyræoides*, D.C. (Pittosporaceæ), Native willow.—Introduced 1924; only one tree, very slow growth. This is a small graceful tree of Victoria, New South Wales, Queensland, South and West Australia growing up to 30 feet; also called weeping Pittosporum and butter bush. It is one of the so-called quinine trees and a useful fodder plant in the dry interior. The wood is pale and very hard.

40. **Pleiogynium solandri*, Engler (Anacardaceæ), Burdekin plum.—Introduced 1918; several trees now florescent and fruiting. A North East Queensland tree, 40 to 60 feet high, known as hog plum on account of its fleshy purple fruit. Wood hard, dark-brown suitable for cabinet work.

41. *Prosopis chilensis* (Mol.), Stuntz (= *P. juliflora*) (Swartz) DC. (Leguminosæ) Algaroba.—Introduced 1918; does well in Fiji (R.B.H.). The honey locust of mesquit comes from Central and South American and has been introduced to a number of countries on account of its pods which are used as food for livestock. The flowers are rich in honey. A spineless form is stated to have been found in Australia.

42. *Punica granatum*, Linn. (Punicaceæ), Pomegranate.—Introduced from America 1920; two or three varieties now fruiting; grown from cuttings specially selected (R.B.H.). This is a handsome small tree originally from the Persian region. It bears red flowers and the fruit is popular in the East, largely on account of its medicinal properties. The rind of the fruit is astringent and is used in tanning and dyeing. The fresh root bark is used as an anthylmetic especially in the treatment for tape worm. The plant is often grown as a hedge plant.

43. **Raphia pedunculata* (Raffia or Raphia).—Introduced 1918; two or three trees growing slowly. A handsome palm of Madagascar with very large, arching feathery leaves 22–28 feet long and ernomous spadices 10–15 feet long. Raffia, used for tying purposes and for mats, baskets, &c., is derived from the cuticle of the leaves of this palm. It is exported from Madagascar and retailed in England at about 3s. or 4s. per lb.

44. **Sarcocephalus cordata*, Mig. (Rubiaceæ), Leichhardt tree.—Introduced 1918; now magnificent large trees flowering and doing well. A handsome tree with yellow flowers in dense globular heads over 1 inch in diameter. Fruit eaten by aborigines and bark used medicinally. The wood retains the bitter taste indefinitely.

45. *Swietenia mahogani* (Meliaceæ).—Introduced 1919; growing strongly. This tree, long noted for its timber, is a native of tropical America. It is a useful shade and ornamental foliage tree, 60–70 feet high with small pinnate leaves; best suited to a rather dry climate.

46. *Ziziphus jujuba*, Lam. (Rhamnaceæ), Jujube tree.—Introduced in 1924; several trees growing well. A small tree from tropical Africa and Asia with recurved thorns; useful for hedges and a common host plant for the lac insect. The fruit when cultivated is known as the jujube plum. As a fruit tree it has been developed in China where there are some valuable varieties. One of the earliest known fruits in Egypt.

## INTRODUCTION OF TROUT INTO FIJI.

By
H. W. JACK, M.B.E., D.Sc.,
Director of Agriculture.

Some prominent anglers resident in Fiji recently reopened the question of the possibility of establishing trout in the hill streams of Fiji as an exhilarating sport, as a possible attraction to tourists making prolonged visits to the Colony and as an additional contribution to the tasty food of the country.

Hence, the following information has been extracted from various official documents, as aids in sizing up the possibilities of the successful introduction of this attractive fish to the Colony.

Mr. G. T. Barker, Curator of the Fiji Museum, states that efforts were made to introduce perch into Fiji in 1910, under the charge of Mr. Brewster Brewster, then District Commissioner at Nadarivatu, but the fish appeared to have been forgotten and left in a pond for three years until a flood swept them away.

In 1919 Mr. E. C. Elliott, Resident Commissioner, Gilbert and Ellice Colony, endeavoured to import some yearling trout from Sydney, but his efforts failed.

In 1920, a small consignment of ova was received from New Zealand before preparation had been made for a suitable hatchery, but a few dozen fry were saved and liberated into the streams at Nadarivatu almost immediately after hatching.

Funds were voted for the project in 1921 and preparations—water race, troughs, &c.,—were made at Navai for receiving largish consignments of ova. In July, 1922, 50,000 ova arrived unexpectedly and no funds were available for handling them, but Mr. Fell, Colonial Secretary, contributed generously, and raised private subscriptions, which enabled the ova to be transported to Navai where some 10,000 fry were hatched out.

Mr. Edwards, District Commissioner, Colo North, Mr. A. P. Fountain and Mr. D. Scott, Cadet, combined to achieve this measure of success.

A further 50,000 ova arrived in August of the same year, again unexpectedly. Mr. Lord of the Colonial Sugar Refining Company generously undertook to see that this consignment reached Navai in good order. From this importation it was estimated that between 30,000 and 40,000 fry were successfully hatched out and liberated into the upper reaches of the Sigatoka River, in which fish 6–8 inches long were subsequently seen on a few occasions.

The hatchery at Navai was situated at 2,800 feet elevation, and the average temperature of the water was said to be 61°F.

The cost of 100,000 ova from the Department of Internal Affairs at Wellington was £20 5s. 2d., the cases, apparently having travelled on the "Navua" freight free, were looked after by the ship's butcher, who was given remuneration on each occasion for his attention to them—maintenance of correct temperatures, *i.e.*, 45°F. to 55°F.

The normal price of the ova at that time was 6s. per 1,000, but the New Zealand Government kindly charged actual expenses only.

In 1921, £378 was spent on the hatchery; of this amount, £133 was paid as salary to the Supervisor for four months and £53 for his travelling expenses, &c. Materials, wages (£7 per mensem), and transport account for most of the balance.

In 1922, £162 was spent up to the 24th March. In March 1923, of £130 collected by private subscription, £99 was still available. In March, 1927, there was still £88 available in the Trout Hatchery Account, and in 1930 this amount was paid into Revenue.

The experimental work done and information gained recently indicate that:—

(1) There is no difficulty in the transport of ova from New Zealand at temperatures as high as 45°F. to 55°F.

(2) There was no difficulty in hatching the ova at Navai.

(3) Stocking from hatcheries should be continued for some years, since acclimatisation takes several years.

(4) Eels and kingfishers are potential predators on the small fry.

(5) Fry tolerate water varying in temperature from 61°F. up to 72°F. though there is some doubt as to whether they will breed in water of temperatures over 60°F. The water in streams at Nadarivatu varies in temperature between 55°F. and 67°F.

(6) There is an adequate stock of natural food in the streams at Navai,

(7) Sand and gravel beds are desirable for spawning, which normally takes place in the third year.

(8) The original hatcheries at Navai were not continued long enough to assure success and permanence.

(9) It might be possible to locate the hatcheries at the base of the waterfalls in our mountain streams but Nadarivatu should be given preference since more predaceous fish would be found in the lowland streams to feed on the young trout.

(10) Under Fiji conditions, it would be best to feed the fry until they are six to eight inches long, before liberation—this would be comparatively costly, as the best food is said to be pulverised and sieved ox liver. Pig liver could be used in place of ox liver, if necessary. Junket made with rennet and milk is also a good feed. Only enough feed should be given at each feeding, so that consumption will be complete. The best period for getting ova from New Zealand is July–August, and the ova hatch out in running water.

(12) Suitable hatching troughs are 10″ x 6″ deep (both internal measurements) by eight feet or preferably longer. The troughs should be painted with bitumastic paint or/and just covered with fine shingle or coarse sand to keep the ova off the bottom. Perforated zinc or gauze is used to cover inlets and outlets of water flow. Hatching takes place in about 28 days at suitable temperature after liberation from the transporting boxes.

(13) The ova in trays, usually of fluted glass or wire gauze, should not be exposed to bright light, and the hatchery should be well shaded. The temperature of the ova cases should gradually be brought to the temperature of the water in the hatcheries before releasing the ova into the hatch troughs.

(14) The fry are very nervous and great care is necessary in their transport, in liberation to prevent frightening them, in sudden changes of water temperature, in the use of suitable aerated water, to liberate them in shallow water which is well provided with cover of the nature of stones, rocks, weeds, &c.

(15) After hatching, the fry do not require to be fed for some eight days, and that any " white " ova (dead) should be removed daily to avoid detriment to live ones.

(16) In hatcheries in New Zealand, the water in the hatcheries is not allowed to flow too fast—the fry should be able to move easily in any direction in the current –one-inch pipe supply without pressure.

(17) It is reckoned in New Zealand that only 10 per cent. of liberated fry ever reach maturity. Also liberation is usual there a few days after hatching out to avoid recourse to feeding. The larger the size at liberation, the higher the percentage to reach maturity.

(18) After liberation of fry, rigid protection of small streams is necessary, but this should not present insuperable difficulties.

(19) If suitable arrangements can be made regarding location and finance, it would seem best to establish a permanent hatchery so as to supply fresh blood to our streams in addition to any natural increase. There would, in time, be a return in food value.

The streams of Nadarivatu, with their moderate flow of water, their dark-bottomed pools and abundant shallow, gravelly reaches well sheltered from winds by verdant banks, should be well suited to the needs of imported trout, These streams are well supplied with food from aquatic plants, from the land, from rocks and gravel, and in the form of grass-hoppers, flies, grass, algae, crickets, minute fish, molluscis, crustaceans, &c., and hence the young fish after distribution from the hatcheries should need little attention other than protection from floods and native fishermen during the first three years.

In New Zealand, silt in the streams does not appear to be detrimental to young brown trout, which have a reputed growth rate of about one to two pounds per annum, but satisfactory stocking takes several years.

At four months old, the young trout should average six inches in length, and ten inches at 12 months old. They are cannibalistic, and hence, young fish should be graded to size every few months in the hatchery and complementary ponds.

(1) Much useful practical information is contained in the following articles: U.S.A. Bureau of Fisheries Document No. 955 of 1923 entitled "Artificial Propagation of Brook Trout and Rainbow Trout, with notes on other species" by Glen C. Leach. (2) U.S.A. Bureau of Fisheries Invsetigational Report No. 22 of 1934 entitled "Care and Diseases of Trout" by H. S. Davis and (3) "The Keeper's Book" 1917 by P. J. Mackie.

These notes are penned for the purpose of indicating that several influential anglers resident in the Colony are anxious that a Trout Acclimatisation Society should be formed in Fiji, in order that it may become possible to take practical steps to start a permanent hatchery during 1940.

Towards this end, any interested persons are requested to communicate with Mr. C. R. Turbet, Senior Veterinary Officer of the Department of Agriculture, who has generously consented to act as Honorary Secretary, should it become possible to establish a local Society.

Already some £200 has been promised towards the purposes of the proposed Society, and the Conservator of Forests and other interested persons have expressed their willingness to aid the Society with practical assistance, but it is estimated that an additional £200 will be required to ensure a satisfactory start and continuity of effort. It is hoped that there may be a good response from local anglers and that the proposed Society will materialise in the near future to discuss ways and means for supporting this absorbing and beneficial sport in the Colony as soon as possible.

## CASTRATION OF PIGS.

By
C. H. KOSTER,
Stock Inspector.

CASTRATION is essential not only because it enables the farmer to control the breeding operations at his piggery without hindrance but because it has many advantages in so far as the pork and bacon pig is concerned resulting in the production of a carcase free from sexual odours and flavours in the meat; also the flesh is of a much finer grain and quality.

The best time to castrate is when the pigs are from four to six weeks old and while they are still suckling the dam, since at that age there is considerably less shock to the system and the growth of the pig will not be checked. A four to six-weeks-old pig can be handled conveniently and the testicles are large enough to render their removal quite simple. The older the pig is the greater the shock and risk, and the more severe the after-effects.

It is advisable that the animal should be starved for at least twelve hours before the operation is to be performed; that all instruments should be thoroughly cleaned and disinfected and free use made of two per cent. solution of some carbolic disinfectant such as sheep dip or of Condy's fluid. Castration should not be done during very cold, windy or rainy weather and a dry cool day is most satisfactory.

Suitable antiseptic oils for use after castration may be made up from one of the following recipes:—

(*a*) one part of carbolic acid mixed with ten parts of olive oil;

(*b*) 1 oz. of iodoform dissolved in 14 ounces of eucalyptus oil to which when quite clear, 30 ounces of olive oil should be added.

These anticeptic dressings stimulate healting and repel flies. The operation is best performed by two persons and everything should be in readiness before the assistant catches the pig. The pig should be held firmly on its back to prevent wriggling which makes the work difficult for the operator. The scrotum or purse and surrounding parts should be thoroughly washed with the disinfectant solution.

The operator seizes one of the testicles between the thumb and forefinger of the left hand, keeping the remaining three fingers closed. An incision is made parallel with the middle line of the body and about half an inch to the side of this line, keeping the cuts low, or in such a position that when the animal stands up the blood will come away and not collect in the scrotum. The incision should be deep enough to enter the fleshly part of the testicle, thus liberating it from the envelope in which it is normally situated, and long enough to free the testicle and allow free drainage. Care should be taken to see that the cuts are not made too close, across the middle line of the body or off the surface of the scrotal sac since cuts in these positions may result in excessive bleeding and soreness.

The correct cuts having been made the testicle is drawn out and the thin tissue immediately under the testicle cut through, after which the testicle, while being drawn away, is scraped, not cut, free from its remaining attachments.

The cord should never be cut off abruptly, except when the emasculator is used, as to do so may cause severe bleeding. Jerking out the testicle is also dangerous, as it may result in rupture. The first testicle having been removed, the second one is also taken out in similar manner but through a second incision made for that purpose.

After the operation, antiseptic oil should be poured into the wounds, and the pig placed in a clean dry pen.

## RAISING VEGETABLES BY WATER-CULTURE.

By
C. HARVEY, B.Sc., A.I.C.T.A.,
Senior Agricultural Officer.

THE increasing interest in the growing of vegetable and flowers without soil, especially in the United States, has led to many extravagant claims being made for this process, which is variously known as water-culture, tray agriculture, tank farming, or recently, as hydroponics. These claims are examined in a recent bulletin of the University of California (Circular 347 of December, 1938). It is pointed out that where soil conditions are suitable, vegetables and flowers can be raised with far less trouble by straightforward market-gardening methods, and though high yields of vegetables may be obtained by water-culture, these are no more than are commonly experienced under greenhouse conditions using soil. Moreover, as practiced by amateurs, water-culture may bring disappointment and failure, due to toxic elements in materials used, or to failure regularly to observe the necessary precautions. Apart from the possible advantages of water-culture as a commercial proposition under certain conditions, it may well have local application in some islands in the Pacific where soil conditions are decidedly unfavourable for the raising of vegetables in the garden; it also has its appeal as a hobby for the "verandah gardener," and it has possibilities for the production of limited quantities of salad vegetables for home consumption in the wet season in Fiji, when garden soils may be too saturated for plants to thrive.

For this reason a brief account is given of materials and method; for a more detailed description, attention is directed to the references given at the end of this article.

Plants draw their mineral requirements from the soil; they also draw on the atmosphere for other requirements through the agency of sunlight. In water-culture the necessary minerals are supplied in solution in water; sunlight is equally necessary as in the case of plants growing in soil. The soil also supports plants during growth; in water-culture this support is provided by wire trays filled with fine shavings, (wood-wool) and moss suspended on the surface of the solution. Alternatively, coarse sand or a mixture of sand and cinders to which the solution is added may be used, the sand (itself containing little or no plant food) functioning as the support; this is "sand-culture" as distinct from "water-culture." There are advantages and disadvantages with either method: in sand-culture no wire support is necessary and the container or trough need not be watertight, on the other hand the solution drains off rapidly and must be collected and re-applied twice daily, and if the sand is too fine, trouble may be experienced due to lack of aeration. In water-culture, the containers must be water-tight, aeration must be provided for, and also supports, but the solution need only be renewed every week or two, except to make good evaporation losses.

For growing vegetables, a convenient container is a trough made of wood, six feet by one foot, by one foot or nine inches deep. For water-culture the container must, of course, be close fitting and should be painted inside with bituminous or asphalt paint (not ordinary paint, which is toxic to plants), and should have a ledge inside, three inches from the top, to support the tray. The tray consists of a shallow wooden frame with a floor of half-inch wire mesh, which is filled with wood-wool and moss. The culture solution is maintained at a level at which the wood-wool is kept constantly moist. Black iron or galvanised iron containers may be used, if painted inside. Glass containers are handy for small scale work; these must be completely covered to exclude light from the solution. For sand-culture, wooden troughs

are very suitable and need not be absolutely water-tight. A drainage hole must be provided at one end, to which the trough should be slightly inclined, and provision for the collection of the drainage must be made. The usual precaution of stones at the bottom to facilitate drainage is taken, and the trough is then filled with clean coarse sand and cinders. Sand that has been in contact with sea-water must be thoroughly washed with fresh water.

The procedure is now as follows: large and medium size seeds may be planted directly into the trays of water-culture troughs; very small seeds may be germinated on damp blotting paper. Once established in the troughs the procedure with water-culture is, first, the maintenance of the level of solution to the lower level of the supporting tray by addition of water when required; second, lifting out the tray each day for half-an-hour to aerate the roots, during which time the solution is agitated briskly with a whisk, or alternatively, by passing air into it with a bicycle pump; third, replacing the solution with a freshly made mixture—every one to three weeks depending on the stage and rate of growth of the plants. With sand-cultures, all except large seeds are preferably grown to seedling stage in shallow trays containing sand, moistened with dilute culture solution, the seedlings being transplanted into the sand trough when a few inches high. The culture solution is added immediately before transplanting. Twice daily the plants must be watered with fresh water to which all the drainings from the trough have been added. Every one to two weeks the sand is flushed out with fresh water and a fresh lot of solution is applied. Care must be taken that the sand is not compacted.

The plants must not be exposed to direct sunlight, but should have plenty of diffused light, as in an open-sided shelter or high-roofed verandah. Complete protection from rain is necessary, or the nutrient solution may be flushed out.

The composition of the nutrient solution is given below, with directions for preparation. It should be noted that some of these chemicals are unobtainable in Fiji and would require to be ordered from overseas. Commercial grade should be asked for, this is much cheaper and as satisfactory as the chemically pure material.

*Stock Solution* A.

One level teaspoonful of Boric Acid ($H_3B\ 0_3$).
One level teaspoonful of Manganese Sulphate ($Mn\ SO_4.\ 7\ H_2O$).
One level teaspoonful of Zinc Sulphate ($Zn\ SO_4.\ 5\ H_2O$).

These are dissolved simultaneously in half a gallon of water. Add to the solution one-eighth ($\frac{1}{8}$) teaspoonful of Copper Sulphate ($Cu\ SO_4.\ 5\ H_2O$).

*Stock Solution B.*

Dissolve one-quarter teaspoonful Ferric Nitrate ($Fe\ (NO_3)_3$) in one pint of water.

*Solution C.*

One and one-quarter ($1\frac{1}{4}$) level teaspoonful Monopotassium Phosphate ($KH_2PO_4$).
Four (4) level teaspoonfuls Calcium Nitrate ($Ca\ (NO_3)_2.4\ H_2O$).
Two and a half ($2\frac{1}{2}$) level teaspoonfuls Magnesium Sulphate ($Mg\ SO_4\ 7\ H_20$).
One-half ($\frac{1}{2}$) teaspoonful Ammonium Sulphate ($(NH_4)_2SO_4$).

Each of these is dissolved separately in about a quart of water, the solutions are then mixed and diluted with water to a total of five gallons. Add to this two teaspoonfuls of Stock Solution A and four teaspoonfuls of Stock Solution B.

*Note.*—(*a*) If commercial grade chemicals are used only one teaspoonful of Stock Solution A is required. (*b*) Stock Solution B must be added to C only just before use.

The " Nutrient Solution " is then ready for application to the troughs.

The London price of these chemicals, medium grade, is given below. Commercial grade would be considerably cheaper:—

| | | |
|---|---|---|
| Monopotassium Phosphate .. | 4s. 3d. | per pound. |
| Calcium Nitrate .. .. | 2s. 9d. | ,, |
| Magnesium Sulphate .. .. | 0s. 6d. | ,, |
| Ammonium Sulphate .. .. | 1s. 2d. | ,, |
| Boric Acid .. .. .. | 2s. 7d. | ,, |
| Manganese Sulphate .. .. | 2s. 7d. | ,, |
| Zinc Sulphate .. .. .. | 1s. 2d. | ,, |
| Copper Sulphate .. .. | 1s. 3d. | ,, |
| Ferric Nitrate .. .. .. | 4s. 1d. | ,, |

REFERENCES.

(1) Circular 347, December, 1938. University of California. The Water-Culture Method for Growing Plants Without Soil. D. R. Hoagland and D. I. Arnon.
(2) *Soilless Growth of Plants.* Ellis and Swaney. 1938.

## EXTRACT.

### INTRODUCTION OF PLEUROTROPIS INTO THE TERRITORY OF NEW GUINEA.

" In 1936, the possibilities of introducing this parasite into this Territory from Fiji were investigated, but a combination of circumstances then prevented it being carried out.

" Early in 1938, a colony of *Promecotheca* larvæ, parasitized by *Pleurotropis parvulus,* was sent from the New Hebrides through the courtesy of M. Dupertuis, but owing to extended delays in transit they were all dead on arrival. Later in the same year, through the assistance of W. R. Carpenter & Co. Ltd., and of the Department of Agriculture, Suva, another colony of adult *P. parvulus* was introduced from Fiji, by steamer to Sydney and thence by aeroplane to Rabaul, but these died en route. Finally, another colony from Fiji arrived alive on 6th September, 1938, partly as adults and partly as pupæ in parasitized adult larvæ *Promecotheca.* This package was despatched in ship's cooler from Fiji to Sydney, where on the ship's arrival, W. R. Carpenter & Co. Ltd. kept the parasites packed in ice, and, without delay, freighted them by mail 'plane to Rabaul.

" The introduction of these parasites over so great a distance without personal and daily attention was due to a set of exceptionally favourable circumstances that are rarely to be met with, owing to the synchronizing of steamer arrival and 'plane departure from Sydney. Any further period of cold storage in transit would almost certainly have been fatal to the parasites.

" The adult parasites received were set on larvæ of *Promecotheca papuana* the same day as received, and breeding work continued until all the parasites died. The first generation was not as large as was hoped for, possibly due to the effect of the long transit in cold storage. The second generation was, however, highly satisfactory, and liberations in the field were commenced within eight weeks of the receipt of the original colony."

—*New Guinea Agricultural Gazette,* Vol. 5, No. 2, March, 1939.

## NEW ZEALAND CENTENNIAL EXHIBITION.

### FIJI'S EXHIBIT.

THE following is extracted from the *Fiji Times and Herald* and should be of general interest locally:—

At the New Zealand Centennial Exhibition, which will open at Wellington, on November 8, Fiji will be represented by a wide and comprehensive display of produce and handiwork. The material for the exhibit recently went forward, accompanied by Mr. D. A. Donald, of the Department of Agriculture, who will be in charge of the Fiji Court, and a Fijian assistant.

The exhibit will be appropriately based in a hut erected on the principle of a "vaka tunuloa," or village meeting house. Materials for the roof thatching were sent from Fiji, together with reeds which will be used for part of the construction. Peeled logs will be used for the columns and the interior of the hut will be lined with tappa and mats. Spears, clubs and other weapons of native warfare, and examples of native handicraft will be used to give the necessary native atmosphere. A further tropical touch will also be added by coconut palms, grown in tubs, which will be placed around the outside of the hut.

Despite the fact that many large firms and the various provinces of New Zealand are spending large sums in the construction of stands and courts, the Fiji Court will probably stand out in contrast by reason of its simple and appropriate design.

The wide range of production in the fertile islands of Fiji is indicated by the diversity of articles exhibited. The sugar cane, sugar and molasses are indicative of the Colony's greatest industry. The Fiji banana, famous for its wonderful flavour and its keeping qualities, and other fruits which may be in season, are exhibited; fresh supplies of these exhibits are being sent from Fiji throughout the period of the Exhibition. There are young coconut palms so emblematic of the tropics and coconuts and their various by-products, including copra, coconut oil, fibre, rope and other articles which are derived from the nut or its husk. There are also models of a small holder's copra drying plant and of a native coconut plantation. Ground nuts (unshelled and shelled), candle-nuts and candle-nut oil, soya bean and its products, and other varieties of oil-bearing nuts are displayed. A wide range of general produce includes kumalas (or sweet potato), yams, dalo, dalo flour, kapok, rice, coffee, ginger, cocoa pods and prepared beans, cocoa powder and cocoa butter, cotton lint, cotton seed, castor seeds and oil, areca nuts, Mauritius beans, tapioca, tapioca flour, arrowroot, arrowroot flour, annatto seeds, which have a commercial use in the manufacture of cheese; also trocas shell, tortoise shell and ornaments manufactured therefrom and biscuits.

An interesting indication of the versatility of Fijian agriculture is the exhibit of Fijian tobacco which is shown in leaf form, and also manufactured in twist tobacco, cigars and cheroots.

The establishment of the pineapple canning industry in Fiji is represented by a display of tinned pineapple, pineapple crush and pineapple juice from the Colonial Sugar Refining Company, Lautoka, and Mr. McCown's factory at Ovalau. Many tropical fruits are eminently suitable for preserving and the industrial possibilities of preserving them are indicated in a very fine display of jellies, pickles, chutney and assorted preserves, made by Mrs. O. Corbett.

The gold mining industry in Fiji, which is rapidly increasing in importance, is represented by an exhibit from the two main gold fields at Tavua and Mr. Kasi, one of the ores sent being insured for £130.

The suitability of Fijian timbers for furniture manufacture is also indicated in a range of very attractive varieties of polished timber panels including the famous " yaka " and the Fiji Kauri.

Also showing the industrial possibilities in Fiji is a display of soaps and biscuits, kindly donated by the Pacific Biscuit Company and Union Soaps Limited.

A close connection with our tourist industry will be provided in a very large and most attractive display of tortoise shell ware provided by Messrs. Noel Levy and T. C. Widdowson. Much of this material has been very attractively made up, and it would not be surprising if this display produced inquiries from New Zealand for this material. The centre piece of this exhibit is the shell of a large tortoise, one half of which has been polished and the other half let in its natural state, which will give some of the raw material from which the numerous articles are made.

The tourist attractions of the Fiji Islands are emphasised through the medium of posters, large photographs, coloured illustrations, and a 12-feet illuminated transparency showing the village of Namosi and a typical beach scene. Maps and general tourist literature are available and the officer-in-charge of the exhibit and the Fijian assistant will supply any information which is desired regarding the Colony.

The Exhibition Committee which is responsible for the organising of the Fiji Court and the selection and collection of exhibits is as follows:—Dr. Jack (chairman), Major C. Brewster, Mr. A. B. Ackland and Mr. F. I. Ryan (secretary).

## ENTOMOLOGICAL NOTES.

By

R. J. A. W. LEVER, B.Sc., D.I.C., A.I.C.T.A., F.L.S.

### 1. A SANDFLY ATTACKING A CATERPILLAR.

PERIODICALLY every year, but especially in February and March and from June to September, leaves of the ornamental *Eranthemum* in Fiji are attacked by caterpillars of the Queensland leaf-butterfly *Doleschallia bisaltide* Cram. *australis* Feld. In February and March, 1939, the writer observed near Suva some nearly full-grown caterpillars with a small fly settled on their upper surface. This proved to be a Ceratopogonid midge or sandfly, determined by the Imperial Institute of Entomology as *Forcipomyia hirtipes* de Meij.

The caterpillars—which pupated normally and seemed none the worse after their phlebotomy—are provided with six stout, black spines per segment, each arising from an " electric " blue boss and bearing stiff hairs on the sides and apex of the spines. At the base of these near the bosses, one, two or, less often, three *Forcipomyia* were feeding quite oblivious of the normal movements of the caterpillar which made no attempt to rid itself of the parasites. No particular region seemed singled out except that only the upper surface and sides were attacked.

Attempts to make the sandfly settle on one's hand pressed against a muslin-covered tube were unsuccessful.

## 2. THE LANTANA BUG (*Teleonemia*.)

In 1928, an insect occurring in Mexico, Central and South America, then referred to as *Teleonemia lantanæ* Dist., was introduced into Fiji from Honolulu whence it had been imported in 1902 to check lantana. Requests were made to Fiji more recently for consignments of this useful insect which accordingly was sent in 1936 to Samoa and Australia and in 1937 to New Caledonia, Tonga and the New Hebrides.

As the Tongan colony did not appear to have become established, the Department of Agriculture, Fiji, was asked to send another lot and this was forwarded from Suva on H.M.S. " Leander " on July 11th, reaching Nukualofa in three days in excellent condition. It is worthy of note that the normal route to Tonga from Fiji is *via* northern New Zealand which besides being very cold for tropical insects involves a journey of three weeks which naturally results in the food-plant being severely drained of sap by the feeding of the insects over such a long period.

As the biology of this insect has been studied fairly thoroughly by Simmonds (1) and Fyfe (2), details will not be included here except to say that eggs were found placed in the tissue of the outer edge of a leaf well away from the veins in which they are normally imbedded. During July, 1939, the life cycle was 19 days of which seven were spent in the egg stage. Simmonds mentions twice in his article " twelve days from egg to adult " but clearly means 12 days from the hatching, not laying, of the eggs. Fyfe records a blackening of tissue " which sometimes occurs some distance from a feeding puncture " but does not refer to the black sticky deposits found on leaves where the insects have been feeding for some time.

An authority on these Tingid bugs, Mr. Carl J. Drake of Iowa State College, has kindly informed the writer that *Teleonemia scrupulosa* Stal. and not *T. lantanæ* Dist. is the accepted name of this insect. The authorities of the Imperial Institute of Entomology not having any available material from Brazil—where the insect was first described—are unable to say if the Fijian specimens correspond with those originally described by Stal. In this connexion it is of interest to note that Perkins and Swezey (3) refer to both species of *Teleonemia* in their list of insects associated with lantana in Mexico during their work there in 1902.

REFERENCES.

(1) Simmonds, H. W., 1929. *Agric. Jour.* Fiji, Vol. II, No. 1.
(2) Fyfe, R. V., 1937. *Jour. Counc. Sci. & Ind. Resch.* Vol. 10, No. 3. August.
(3) Perkins, R.C.L. & Sweezey, O.H. 1924 *Bull. Expt. Station*, Hawaiian Sugar Planters' Assoc. Entom. Ser. Bull. No. 16. September.

## 3. COPRA MITE (*Caloglyphus*).

A sample of copra sent by the Agricultural Assistant, Levuka, was found infested with a small cream-coloured mite. Through the kindness of the Senior Research Officer of the Division of Entomology, Canberra, this mite was identified by Mr. H. Womersley as *Caloglyphus mycophagus* Meguin which is recorded in western Europe frequenting cheese, flour, bran, dead insects and various organic foodstuffs (1).

The sample of copra was classified by the Senior Chemist as being just good enough for grade two (dirty, mouldy, irregular, rancid and small with 7 to 8 per cent. of water) and it is probable that this mite—like *Rhizoglyphus* in Malaya (2)—abounds both in poor quality, mouldy copra or good quality mouldy copra if covered with the surface moulds *Aspergillus* and *Penicillium*.

Hence in copra of good quality stored under clean conditions away from rice and for the minimum storage time, this mite will not be of any importance.

(1) Cotton, R. T., and Good, N.E., 1937. United States Department of Agriculture, Miscell. Publcn. No. 258.
(2) Corbett, G. H., Yusope, M., and Hassan, A., Department of Agriculture, S.S. and F.M.S., 1937. Scientific Series, No. 20.

# INDEX TO VOLUME 10


A

Agricultural Show ..... 4, 110
Artichoke, Jerusalem ..... 2, 34
Avocado borer ..... 1. 7

B

Bananas, export to U.S.A. ..... 3, 72
Beetle borer ..... 1, 7
Beetle, tiger ..... 1, 20
Bug, lantana ..... 4, 125

C

Cabbage Butterfly ..... 2, 38
Calf Pens ..... 3, 78
Castration, Pigs ..... 4, 120
Chemical Notes ..... 2, 46; 3, 87
*Colocasia* ..... 4, 102
Composting ..... 2, 33
Constants, Milk ..... 3, 68
Conservation, Soil ..... 1, 7
Copra—
  Digestibility ..... 4, 105
  Drier ..... 4, 109
  Drying ..... 4, 107
  Grading ..... 2, 39
  Green ..... 4, 206
  Husking ..... 7, 108
  Industry ..... 1, 2
  Mite ..... 4, 126
  Oil Content ..... 4, 104
  Prices ..... 4, 104
  Uniformity ..... 4, 105
Cultivation, Vegetable ..... 2, 43
Cutworms ..... 3, 84

D

Dalo ..... 4, 102
Deficiency, food ..... 1, 24

E

Erosion, Soil ..... 1, 5
Experimental Station ..... 3, 76
Extracts—
  Cold Storage for Insects ..... 1, 28
  Conferences ..... 2, 54, 58
  Forestry ..... 2, 59, 60, 61
  Hymenoptera ..... 1, 28
  Plantations, Exports ..... 2, 62
  *Pleurotropis* ..... 4, 123
  Tobacco Federation ..... 2, 62

F

Food Production ..... 3, 65
Fungus, edible ..... 1, 23

G

Giant Toad ..... *see* Toad
Green Manure ..... 3, 82
Guava Caterpillar ..... 2, 35

I

Introduced Plants ..... 4, 112
Introduction, Trout ..... 4, 117

J

Jerusalem, artichoke ..... 2, 34

L

Lantana bug ..... 4, 125
Leaf-hopper, rice ..... 3, 83

M

Meteorology ..... 1, 29; 2, 46
Milk constants ..... 3, 68
Mineral analyses ..... 2, 46
Mite, copra ..... 4, 126
Mosquitoes ..... 1, 2; 3, 83

N

New Zealand Exhibition ..... 4, 124
Non-fruiting Trees ..... 2, 41

P

Palm, sago ..... 1, 21
Parasites, Local ..... 2, 38
Pens, Calf ..... 3, 78
Pests, Vegetable ..... 1, 11
Pig, Castration ..... 4, 120
Plants, Introduced ..... 4, 112
*Pleurotropis* ..... 1, 19
Production, food ..... 3, 65
  „ vegetable ..... 4, 98

R

Rainfall, 1938 ..... 1, 29
Reviews—
  Agriculture in England ..... 2, 52
  Aircraft, insects in ..... 2, 50
  Cacao ..... 3, 75
  Colonial Markets ..... 1, 27
  Copra, Empire ..... 2, 47
  Fig Moth ..... 4, 108
  Fruit-flies ..... 3, 93
  Green manuring, citrus ..... 2, 51
  Hides, treatment ..... 1, 24
  Land Settlement ..... 1, 26; 2, 48
  Mycorrhiza ..... 1, 25
  Nutrition ..... 1, 26
  Oils, essential ..... 2, 49
  Peanuts ..... 1, 26
  Polyploid Plants ..... 2, 53
  Soya Bean ..... 1, 26
  Stored grain pests ..... 3, 91, 92
  Turmeric ..... 2, 50
Rice Cultivation ..... 3, 80
  „ Insects ..... 3, 85
  „ Leaf-hopper ..... 3, 83
  „ Variety Trials ..... 3, 73

S

Sago Palm ..... 1, 21
Sand-fly ..... 4, 125
Sigatoka Station ..... 3, 76
Silverfish ..... 2, 36
Small holdings ..... 2, 33
Soil Conservation ..... 1, 7
  „ Erosion ..... 1, 5
Stock deficiency ..... 1, 24

T

Termites ..... 1, 18; 2, 36, 37; 3. 87
Terracing, soil ..... 1, 7
Tiger beetle ..... 1, 20
Toad, giant ..... 1, 20; 2, 39
Trees, non-fruiting ..... 2, 41
Trout introduction ..... 4, 117

U

U.S.A., bananas to ..... 3, 72

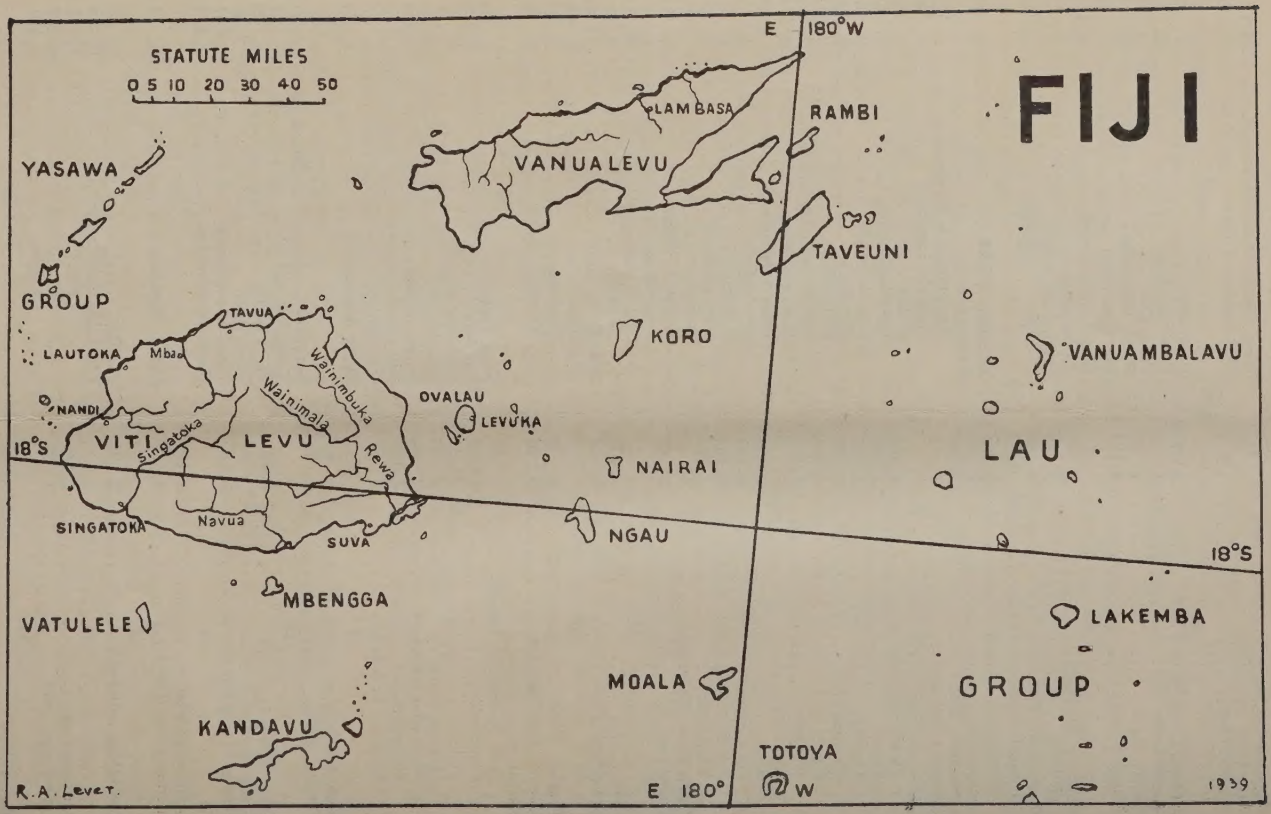
V

Vanilla ..... 2, 42
Vegetable Cultivation ..... 2, 43
  „ Pests ..... 1, 11
  „ Production ..... 4, 98
  „ Raising ..... 4, 121

W

Water Culture ..... 4, 121
Weeds ..... 1, 21
White ants ..... 1, 18; 2, 36-7; 3, 87


—R.J.A.W.I.


FIJI
STATUTE MILES
0 5 10 20 30 40 50
E 180°W
LAMBASA
RAMBI
VANUALEVU
YASAWA
GROUP
TAVEUNI
TAVUA
LAUTOKA
Mba
KORO
VANUAMBALAVU
NANDI
Wainimbuka
Wainimala
OVALAU
LEVUKA
18°S
VITI
LEVU
Singatoka
Rewa
NAIRAI
LAU
SINGATOKA
Navua
SUVA
NGAU
18°S
MBENGGA
VATULELE
LAKEMBA
MOALA
GROUP
KANDAVU
TOTOYA
E 180°
W
R.A. Levet.
1939